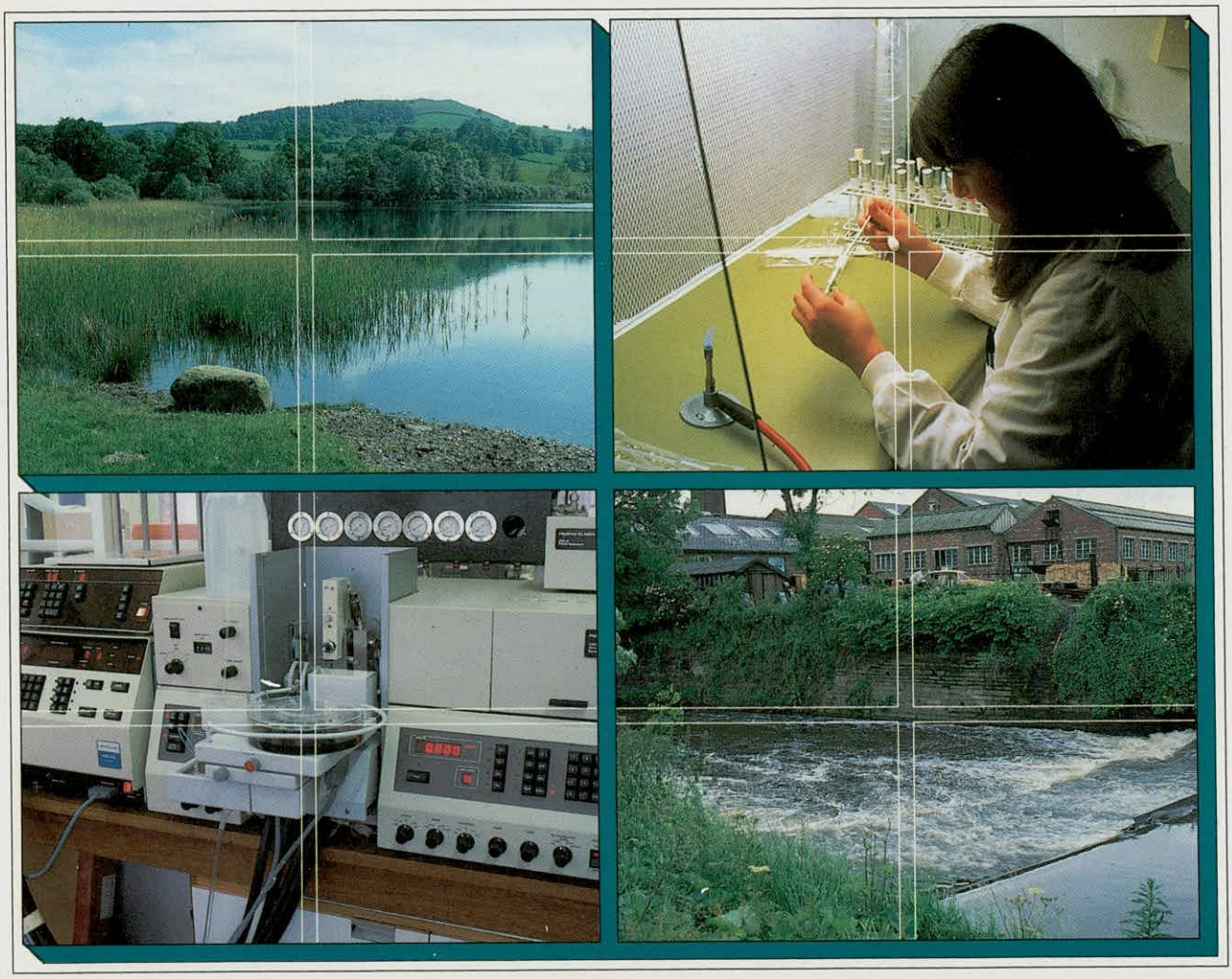
Institute of Freshwater Ecology

Visit to the Czech Republic

- EWRS International Workshop on Plant Invasions, at Kostelec nad Černými lesy
- field trip to the North of the Czech Republic and
- visit to the AS CR Institute of Botany at Třeboň, South Bohemia

F.H. Dawson, PhD CBiol



Natural Environment Research Council

INSTITUTE OF FRESHWATER ECOLOGY
River Laboratory, East Stoke, Wareham, Dorset BH20 6BB

Tel: -44-929 462314
Fax: -44-929 462180

Visit to the Czech Republic
- EWRS International Workshop on Plant Invasions, at Kostelec nad Černými lesy,
- field trip to the North of the Czech Republic and
- visit to the AS CR Institute of Botany at Třeboň, South Bohemia.

Project leader:	F.H. Dawson PhD CBiol
Report date:	December 1993
Report to:	British Council, Prague
Contract No:	Letter of 1 July 1993
IFE Report Ref:	RL/T11053g5/1
TFS Project No:	T11053g5/1

The Institute of Freshwater Ecology is part of the Terrestrial and Freshwater Sciences Directorate of the Natural Environment Research Council.

Table of Contents

International Workshop 1992

Ecology and Management of Invasive Riparian and Aquatic Plants

SUMMARY STATEMENT

The International Centre of Landscape Ecology (ICOLE) organised an international workshop entitled "Ecology and Management of Invasive Riparian and Aquatic Plants" which was held at Loughborough University on 22-23 April 1992. The workshop was initiated by ICOLE in response to growing concern about the problems of introduced plants invading river corridors and other habitats in the UK and in many other European countries. For organisations such as the National Rivers Authority, invasive species are posing serious problems within areas of flood defence, conservation and recreation. Great interest for the workshop was shown from European countries with environmental scientists attending from Denmark, Sweden, Czechoslovakia, Eire, U.S.A, England, Wales and Scotland along with representatives from local authorities, fisheries agencies, river authorities, higher education and government research institutes and the agro-chemical industry. The delegates pooled their knowledge in the quest for effective control measures which are acceptable in sensitive habitats such as rivers and their banks.

Japanese knotweed completely dominates whole sections of river corridor to the exclusion of all native species, threatening nature conservation resources. Giant hogweed causes similar problems but in addition, contains toxic chemicals in its leaves and is an increasing health hazard especially to young people. Swamp stonecrop is taking over ponds and other water bodies around the UK.
Despite the expenditure of millions of pounds on their control, species such as Japanese knotweed, Giant hogweed and Swamp stonecrop are still spreading rapidly.

Delegates in a plenary session at the end of the meeting were in unanimous agreement over the need for:

- A better understanding of the ecology of invasive plants in order to control them effectively and to prevent further spread.

- Further research in areas such as: hybridization with other native species, the potential for increase in climatic range as a result of global warming and the potential for biological control.

- Appropriate and effective legislation on moving/selling plants and seeds of invasive species. There is a problem in that some of these invasive plants are are still sold by suppliers of aquatic and terrestrial plants, even Japanese knotweed and Giant hogweed, which are included in Schedule 9 (Part II) of the Wildlife and Countryside Act 1981. Also that the 1981 Act **does not** include many of the species which are a problem.

- The immediate establishment of a network for the surveillance of invasive plants already causing problems in certain countries which could spread to cause problems in other countries. By learning from the expertise from abroad potential problems can be avoided. For example, the invasion of Salt cedar in the USA is correlated with low flows of the rivers. This has direct implications for a number of European countries where long term drought and low flows are present day problems.

- The raising of awareness in the relevant local authorities and governmental bodies and production of publicity leaflets to inform the public. At present most local authorities and governmental bodies do not consider invasive weeds as a serious problem which needs high priority, unless they have great health & safety and/or economic/agricultural implications.

- A co-ordinated and continuous approach in the control of invasive species. A co-ordinated control strategy would include steps such as; surveys to identify the extent of the problem, liaison with other agencies and landowners, information production, implementation of control, monitoring and logging of the control measures. At present most agencies such as local authorities, National Rivers Authority, British Rail and private land owners are controlling invasive species mostly on an *ad hoc* basis with high cost implications and with relatively little success.

2nd International Workshop: **16-19th September 1993**

Venue: **Czechoslovakia Academy of Sciences**
Trebon

Contact:

Dr. Karel Prach
Institute of Botany
Czechoslovakia Academy of Sciences
CS-379 82 Trebon
Czechoslovakia
FAX 010 42 333 2391

PLANT INVASIONS - THEORY AND APPLICATIONS - programme

Kostelec nad Černými lesy, September 16-19, 1993

16.9

8.00-9.00 Registration
9.00-9.15 Introduction

Block I GENERAL PROBLEMS OF PLANT INVASIONS (chaired by Max Wade)

9.15- 9.55 Rejmánek M. - What makes a species invasive?
9.55-10.25 Kowarik Ingo Time-lags in biological invasions with regard to the success and failure of species
10.25-10.55 Pyšek P., Prach K. & Šmilauer P. - Invasion success related to plant traits: an analysis of Czech alien flora
10.55-11.20 COFFEE BREAK
11.20-11.50 Vogt Andersen U. - The dispersal strategies of weeds in Denmark
11.50-12.00 Květ J. - Why are certain European plants invasive in North American wetlands? (contribution to discussion)
12.00-12.30 General discussion

12.30-14.00 LUNCH

Block II INVASIONS IN PARTICULAR HABITATS (chaired by Marcel Rejmánek)

14.00-14.30 Abernethy V.J., Hills J.M., Sabbatini M.R. & Murphy K.J. - Are there differences between traits of invasive and non-invasive plant species in European wetland ecosystems?
14.30-15.00 Puntieri J.G., Gobbi M. & Calvelo S. - After fire invasion by alien weeds - a 5 year study from Argentinian *Nothofagus* forest
15.00-15.20 COFFEE BREAK
15.20-15.50 Rejmánek M. - Pattern of plant invasions in the tropics
15.50-16.20 Ferreira M. T. & Moreira I. - The invasive component of the macroflora from river systems within agricultural mediterranean area
16.20-16.50 General discussion

16.50-18.00 POSTER SESSION

18.00 DINNER

20.00 WELCOME PARTY

17.9.

Block III SPECIES INVASIVE IN AQUATIC AND RIPARIAN HABITATS
(chaired by Jan Květ)

9.00- 9.30 Sukopp H. & Starfinger U. - *Reynoutria sachalinensis* (F. Schmidt Petrop.) Nakai in Far East and Europe
9.30-10.00 Brock J.L., Child L.E., de Waal L. & Wade P.M. - The invasive nature of Japanese Knotweed (*Fallopia japonica*) is enhanced by vegetative regeneration from stem tissues

10.00-10.30 Bailey J.P. & Child L.E. - Assessment of the genetic variation and spread of British populations of Japanese Knotweed (*Fallopia japonica*) and its hybrid *F.* x *bohemica*
10.30-10.50 COFFEE BREAK
10.50-11.20 Caffrey J. - Growth characteristics, invasive potential and control of Giant Hogweed in Ireland
11.20-11.50 Tiley G.E.D. & Philp B. - The distribution, biology and control of Giant hogweed in Scotland
11.50-12.20 Bramley J.L. & Reeve J.T. - The distribution of an alien duckweed, *Lemna minuta*, within the British Isles; identification, niche constraints and dispersal strategies
12.20-12.45 General discussion

12.45-14.00 LUNCH

Block IV CONTROL AND MANAGEMENT (chaired by John Brock)

14.00-14.30 De Waal L. - Field trials: Treatment of *Fallopia japonica* - a case study
14.30-15.00 Child L.E. & Spencer-Jones D. - Treatment of *Crassula helmsii* - a case study
15.00-15.30 Dawson F. H. - *Crassula helmsii* - its invasion of north western Europe and the potential control strategies for nature reserves
15.30-16.00 General discussion

16.00-16.30 COFFEE BREAK

Block V MISCELLANEA (chaired by Joe Caffrey)

16.30-17.00 Gritten R. - *Rhododendron ponticum* in the Snowdonia National Park - its success as an invasive species
17.00-17.30 Herben T.

17.30-18.00 Jarošík V. & Kocourek F. - Are there any special traits of invasive herbivorous insects related to plant characteristics?
18.00-18.30 General discussion

18.30 DINNER

20.00-21.00 CONCLUSION SESSION

LIST OF POSTERS

Eliáš P. - Invasive behaviour of alien annuals
Fowler S.V., Evan H. & Schroeder D. - Classical biological control for invasive aquatic and riparian weeds: current programmes and future prospects
Husák Š. - Water weeds spread and its reasons
Lukač G. - Diversity and species richness of goldenrod communities in riparian habitats in north-western Croatia
Prach K. & Pyšek P. - Invasion dynamics of *Impatiens glandulifera* - a century of spreading

List of lectures

Abernethy V.J., Hills J.M., Sabbatini M.R. & Murphy K.J. - Are there differences between traits of invasive and non-invasive plant species in European wetland ecosystems?

Bailey J.P. & Child L.E. - Assessment of the genetic variation and spread of British populations of Japanese Knotweed (*Fallopia japonica*) and its hybrid *F.* x *bohemica*

Bramley J.L. & Reeve J.T. - The distribution of an alien duckweed, *Lemna minuta*, within the British Isles; identification, niche constraints and dispersal strategies

Brock J.L., Child L.E., de Waal L. & Wade P.M. - The invasive nature of Japanese Knotweed (*Fallopia japonica*) is enhanced by vegetative regeneration from stem tissues

Caffrey J. - Growth characteristics, invasive potential and control of Giant Hogweed in Ireland

Dawson F. H. - *Crassula helmsii* - its invasion of north western Europe and the potential control strategies for nature reserves

Ferreira M. T. & Moreira I. - The invasive component of the macroflora from river systems within agricultural mediterranean area

Gritten R. - *Rhododendron ponticum* in the Snowdonia National Park - its success as an invasive species

Child L.E. & Spencer-Jones D. - Treatment of *Crassula helmsii* - a case study

Jarošík V. & Kocourek F. - Are there any special traits of invasive herbivorous insects related to plant characteristics?

Kowarik I. - The role of alien species in urban flora and vegetation

Kowarik I. - Time-lags in biological invasions with regard to the success and failure of species

Květ J. - Why are certain European plants invasive in North American wetlands? (contribution to discussion)

Puntieri J.G., Gobbi M. & Calvelo S. - After fire invasion by alien weeds - a 5 year study from Argentinian *Nothofagus* forest

Pyšek P. & Prach K. - Invasion success related to plant traits: an analysis of Czech alien flora

Rejmánek M. - Pattern of plant invasions in the tropics

Rejmánek M. - What makes a species invasive?

Sukopp H. & Starfinger U. - *Reynoutria sachalinensis* (F. Schmidt Petrop.) Nakai in Far East and Europe

Tiley G.E.D. & Philp B. - The distribution, biology and control of Giant hogweed in Scotland

Vogt Andersen U. - The dispersal strategies of weeds in Denmark

De Waal L. - Field trials: Treatment of *Fallopia japonica* - a case study

List of posters

Eliáš P. - Invasive behaviour of alien annuals

Fowler S.V., Evan H. & Schroeder D. - Classical biological control for invasive aquatic and riparian weeds: current programmes and future prospects

Husák Š. - Water weeds spread and its reasons riparian habitats in north-western Croatia

Prach K. & Pyšek P. - Invasion dynamics of *Impatiens glandulifera* - a century of spreading

List of participants

Victoria J. Abernethy
Department of Botany, Glasgow University, Glasgow, G12 8QQ, United Kingdom

Beate Albertenst
Institut für Landschafts- und Pflanzenökologie, Univ. Hohenheim, D-70593 Stuttgart, Germany

John P. Bailey
Botany Department, University of Leicester, Leicester LE1 7RH, United Kingdom C0533 522522)

Philip R.F. Barrett
Aquatic Weed Research Unit, Broadmoor Lane, Sonning, Reading, RG4 OTH, United Kingdom

John L. Bramley
Ecology Research Group, Christ Church College, North Holmes Road, Canterbury CT1 1QU, United Kingdom

John H. Brock
School of Agribusiness and Environmental Resources, Arizona State University, Tempe, Arizona 85287-3306, USA

Joseph M. Caffrey
Central Fisheries Board, Mobhi Road, Glasnevin, Dublin 9, Ireland

Lois E. Child
International Centre of Landscape Ecology, Department of Geography, Loughborough University, Loughborough, Leics LE11 3TU, United Kingdom

F. Hugh Dawson
Institute of Freshwater Ecology, River Laboratory, East Stoke, Wareham, Dorset BH20 6BB, United Kingdom

Louise de Waal
Department of Geography, Loughborough University, Loughborough, Leics LE11 3TU, United Kingdom

Marianne Díaz
Institut für Phytomedizin, Universität Hohenheim, D-70599 Stuttgart, Germany

Pavol Eliáš
Botanical Institute, Slovak Academy of Sciences, Dúbravská 14, SQ-842 23 Bratislava, Slovak Republic

M. Teresa Ferreira
Dept. Forestry, Inst. Sup. Agronomia, Tapada da Ajuda, 1399 Lisboa, Portugal

Simon V. Fowler
International Institute of Biological Control, Silwood Park, Buckhurst Road, Ascot, Berks SL5 7TA, United Kingdom

Rod H. Gritten
Snowdonia Natural Park, Penrhyndeudraeth, Gwynedd LL48 6LS, United Kingdom

Bernd Hayen
Roonstr. 7, D-26122 Oldenburg, Germany

Tomáš Herben
Botanical Institute, Academy of Sciences of the Czech Republic, CZ-25243 Průhonice, Czech Republic

Jeremy M. Hills
Department of Botany, Glasgow University, Glasgow G12 8QQ, United Kingdom

Štěpán Husák
Botanical Institute, Academy of Sciences of the Czech Republic, Dukelská 145, CZ-379 82 Třeboň, Czech Republic

Vojtěch Jarošík
Department of Zoology, Charles University Prague, Viničná 7, CZ-128 44 Prague 2, Czech Republic

Ingo Kowarik
Universität Hannover, Inst. f. Landschaftspflege und Naturschutz, Herrenhäuser Str. 2, D-3000 Hannover, Germany

Stefanie Kraas
Institut für Landschafts- und Pflanzenökologie, Univ. Hohenheim, D-70593 Stuttgart, Germany

Jan Květ
Botanical Institute, Academy of Sciences of the Czech Republic, Dukelská 145, CZ-37982 Třeboň, Czech Republic

Goran Lukač
Department of Botany, Faculty of Science, University of Zagreb, Markuličev trg. 20/II, 4100 Zagreb, Croatia

Ilídio Moreira
Dept. Forestry, Inst. Sup. Agronomia, Tapada da Ajuda, 1399 Lisboa, Portugal

Karel Prach
Institute of Botany, Czech Academy of Sciences, CZ-379 82 Třeboň, Czech Republic

Javier G. Puntieri
Institute of Applied Ecology, CZ-281 63 Kostelec, Czech Republic

Petr Pyšek
Institute of Applied Ecology, CZ-281 63 Kostelec, Czech Republic
(010-42-203-97521, Fax -97500)

Jo T. Reeve
Ecology Research Group, Christ Church College, North Holmes Road, Canterbury CT1 1QU, United Kingdom

Marcel Rejmánek
Department of Botany, University of California, Davis, CA 95616, USA

Mario R. Sabbatini
Department of Botany, University of Glasgow, Glasgow G12 8QQ, United Kingdom

David Spencer-Jones
'Plowmans', Park Road, Forest Row, Sussex RH18 5BX, United Kingdom

Uwe Starfinger
Institut für Ökologie der Techn. Univ., Schmidt-Ott Str. 1, 1000 Berlin 41, Germany

Gordon E.D. Tiley
Environmental Sciences Department, Scottish Agricultural College, Auchincruive, Ayr KA6 5JA, Scotland, United Kingdom

Ulla Vogt Andersen
Royal Veterinary & Agricultural University, Botanical Section, Rolighedsvej 23, DK-1958 Frederiksberg C, Denmark

Paul M. Wade
Department of Geography, Loughborough University, Loughborough, Leics LE11 3TU, United Kingdom

Participants at European Weed Research Society International Workshop on Plant Invasions - Theory and Applications, 16-19 September 1993, Kostelec nad Černými lesy.

Kostelec nad Černými lesy

("Castle in Black Forest")

Brief information on the town and its vicinity

The area: A mosaic of forests, arable land and small settlements, largely colonized as early as in the 8th century B.C. and flourishing even in the Celtic period 500-200 B.C.; the first Slavonic settlements in the 9th century A.C.; a massive colonization in early Middle Ages. Because of the position of the area on the border between two earlier counties, the existence of a large hunting area and less fertile soils, the forests have remained in rather large extent. The former beech woods were mostly converted into Norway-spruce monocultures starting in the beginning of the 19th century. Altitude mostly between 250-400 m; mean annual temperature about 8°C, and annual precipitations 600-650 mm.

The town: An old Slavonic fortificated settlement with a small church built in the 10th century A.D. In the beginning of the 14th century, a castle was built by a Czech King and in the second half of the 15th century the settlement received privileges as a town. The former gothic castle was rebuilt in 1558-1561 in the renaissance style and has remained nearly untouched ever since. A gothic church and earlier fortification were incorporated into the complex. It represents one of the typical and best preserved Central European renaissance mansions. Since 1934, the Research Institute for Forestry, later on as Institute of Applied Ecology, Faculty of Forestry, Agriculture University, Prague, has been located in the castle.
The church (of Holy Angels) on the square was built between 1735-1737 in the typical baroque style, the tower was completed at the end of the last century. In the town you can see more baroque houses, barns, statures, etc., unfortunately, some of them were damaged during the past four decades.

Brief excursion guide, Sat. Sept. 18

Departure at 8 a.m. from Kostelec

Locality no. 1 - River bank of the Elbe River before the confluence with the Vltava River (two main Czech rivers); a fringe of *Impatiens glandulifera, Bidens frondosa* and common native species; other aliens around: *Impatiens parviflora, Rumex thyrsiflorus, Oenothera biennis, Solidago canadensis, Galinsoga parviflora* and *G. ciliata, Amaranthus retroflexus, Erigeron canadensis, Matricaria discoidea, Robinia pseudoacacia*; the river was canalized in the second half of the last century.

Locality no. 2 - Village of Chřibská in the valley on the contact between the eruptive bedrock of the Lužické hory Hills and soft-sandstone area of the Českosaské Švýcarsko (the latter has been suggested as a new national park); well preserved wooden rural houses originated in the 18th and 19th centuries; invasion of *Reynoutria japonica* and *Impatiens glandulifera* along the stream Chřibská Kamenice.

Locality no. 3 - Massive invasion of *Pinus strobus* in the Českosaské Švýcarsko area; a system of deeply eroded valleys and exposed rocks of soft-sandstone; other aliens: *Digitalis purpurea, Impatiens parviflora, Juncus tenuis.*

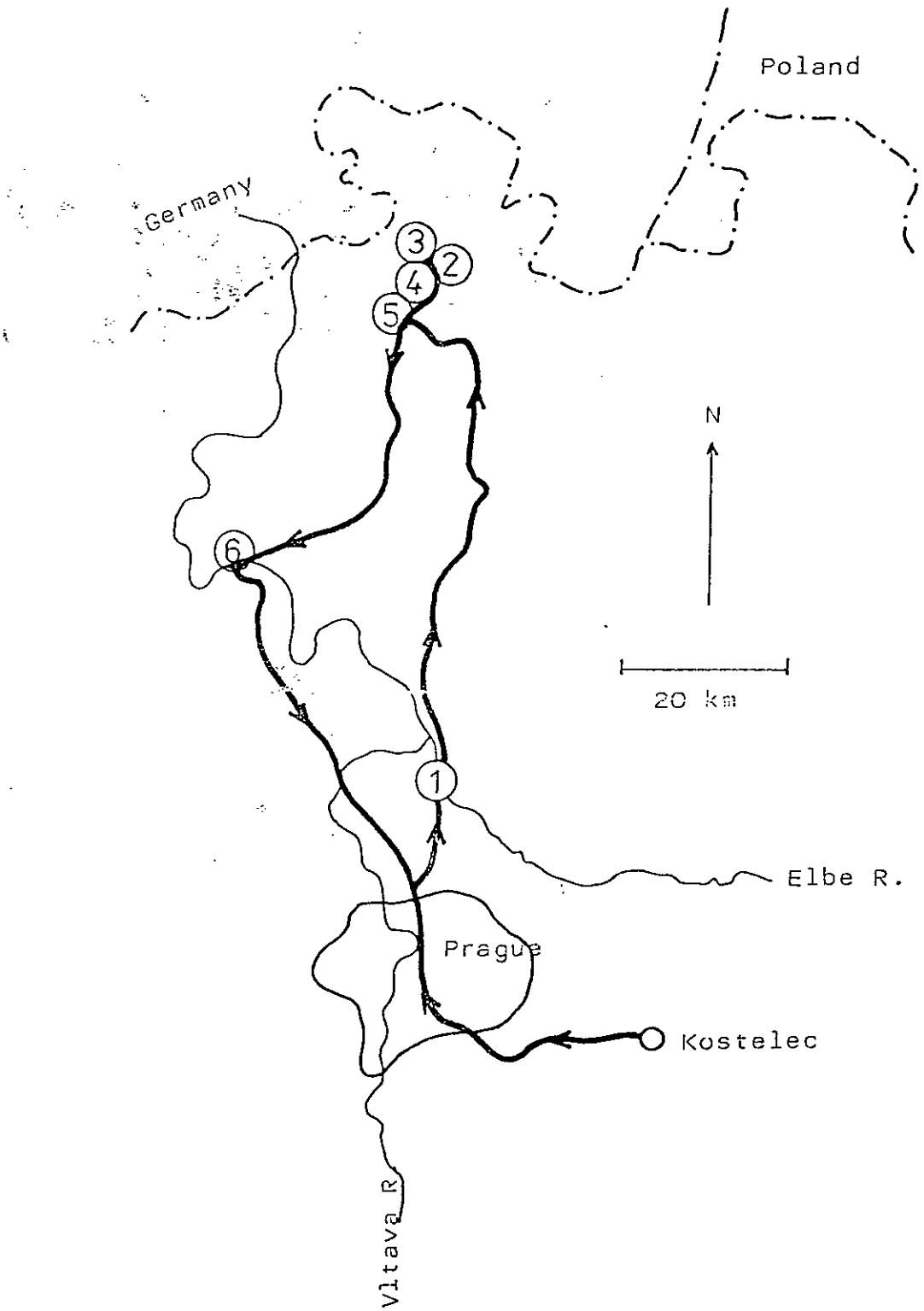
Locality no. 4 - Lunch in a restaurant in an adapted rural house; a scenic view.

Locality no. 5 - A short stop at the bridge across a small stream in the town Česká Kamenice; invasion of aliens along the stream: *Reynoutria japonica, Impatiens glandulifera, Bidens frondosa, Cymbalaria muralis.*

Locality no. 6 - A short visit into one of typical Czech historical towns Litoměřice, coffe break; the town is one of the oldest in the country, flourishing in the Middle ages (gothic period) and latter in the baroque period (18th century), many well preserved historical monuments especially from the latter period.

Return back to Kostelec between 6 and 7 p.m.

Route of excursion, Sept.18



7. Invited 2-day visit (South from Prague) to AS CR Institute of Botany, Section of Plant Ecology at Třeboň, South Bohemia.

The laboratory was visited, introductions made and discussions held which included:

Dr Jan Pokorny, the Section Director, during which an invitation to visit for a period was made; during this time

several booklets and reprints were given to FHD for personal use or the IFE River Laboratory on 'the work and researches of the Třeboň Laboratory';

visiting the Culture collection (formed in 1913) and its maintenance costs and uses (the IFE Laboratory at Windermere houses the UK Culture Centre for Algae and Protozoa);

the novel use of algal for nutrient assessment of waters;

the 'wet' Herbarium with its very useful and instructive collection of water and riparian plants maintained by Dr. L. Adamec; and various glasshouse cultivation facilities with the collections of insectivorous plants;

trials on use of farm waste slurries by students from Ghana (Gloria Addico) and Uganda (Busulwa Henry); and

visiting and discussing the functioning and economics of the novel experimental solar-heated and thermal-storage glasshouses.

The local field station was also visited and the opportunity was taken to accompany local students on a field expedition around lakes, rivers and woodland.

8. Proposals for future contact.

Several invitations were exchanged for visits to the Czech Republic and to the UK of which:

Petr Pyšek was invited to visit the IFE River Laboratory (IFE to pay inland travel expenses) and to stay with FHD in Dorset, together with his family during his proposed study visit (1994) to Oxford, UK;

Karel Prach was invited to visit the IFE River Laboratory (IFE to pay inland travel expenses) when appropriate;

Jan Květ for inviting me to visit the IFE River Laboratory during his next trip to the UK in relation to international wetlands (IFE to pay inland travel expenses);

Several members were invited to visit the IFE River Laboratory for appropriate studies or periods and it was agreed that financial arrangements should be explored.

FHD was invited for a short sabbatical at the AS CR Institute of Botany, Section of Plant Ecology at Třeboň, South Bohemia.

[also, a UK research student, Jo Reeve, was invited to and has already taken an initial opportunity, to visit the IFE River Laboratory for assistance with her PhD work on nutrient uptake by water plants for Tertiary treatment of waste waters; a subject of interest to the Institute of Botany, at Třeboň.]

In addition, discussions for proposals for pan-european studies were initiated on:

- the use of aquatic plants for environmental quality assessment with particularly with Ferreira (Portugal) and others;

- cooperative work on water plant distribution and control with Caffrey (Ireland); and in addition, UK national cooperative studies.

The absence of information and coordination between British based initiatives especially that of the NERC Seminar 'Managing science in a market driven economy' and co-sponsored by The British Council Prague, immediately following the conference was unfortunate particularly as some senior prospective Czech participants were unable to attend as they were involved with ad-hoc visits to their bases by conference participants.

9. Acknowledgements

I wish to thank:

The British Council, Prague, Czech Republic for contributing to travelling expenses;

Institute of Freshwater Ecology for contributing to subsistence and costs within the Republic;

Petr Pyšek and Karel Prach for organising a very interesting conference;

Jan Květ for inviting me to visit the Botanical Institute at Třeboň and also to Jan Pokorny and Stephan Husek.

Appendix 1. Paper and overheads as presented at:

European Weed Research Society International Workshop on Plant Invasions - Theory and Applications, 16-19 September 1993, Kostelec nad Černými lesy.

Crassula helmsii - its invasion of north-western Europe and the potential control strategies for nature reserves.

F.H. DAWSON

NERC Institute of Freshwater Ecology,
River Laboratory, East Stoke, Wareham, Dorset, U.K.

(Tel: 44-(0)929-462314; Fax: -462180) direct line -405583..(pause)..204
(Electronic Mail: RL_FHD@UK.AC.NERC-WAREHAM.VAX) (checked regularly)
or RL_RLM@UK.AC.NERC-WAREHAM.VAX (checked daily)

European Weed Research Society International Workshop on Plant Invasions - Theory and Applications, 16-19 September 1993, Kostelec nad Černými lesy, Czech Republic.

CRASSULA HELMSII - ITS INVASION OF NORTH-WESTERN EUROPE AND THE POTENTIAL CONTROL STRATEGIES FOR NATURE RESERVES.

F.H. DAWSON

NERC Institute of Freshwater Ecology

OUTLINE

The distribution and habitat in Australia
- competitors
- temperature - min/max
- rainfall
- water chemistry - nutrient, salinity
- water flow
- altitude

Prediction of distribution in NW Europe
- based on Climatic data for Australian habitat

The current situation in Europe

The reason for its present distribution Europe
- comparison of UK with mainland Europe

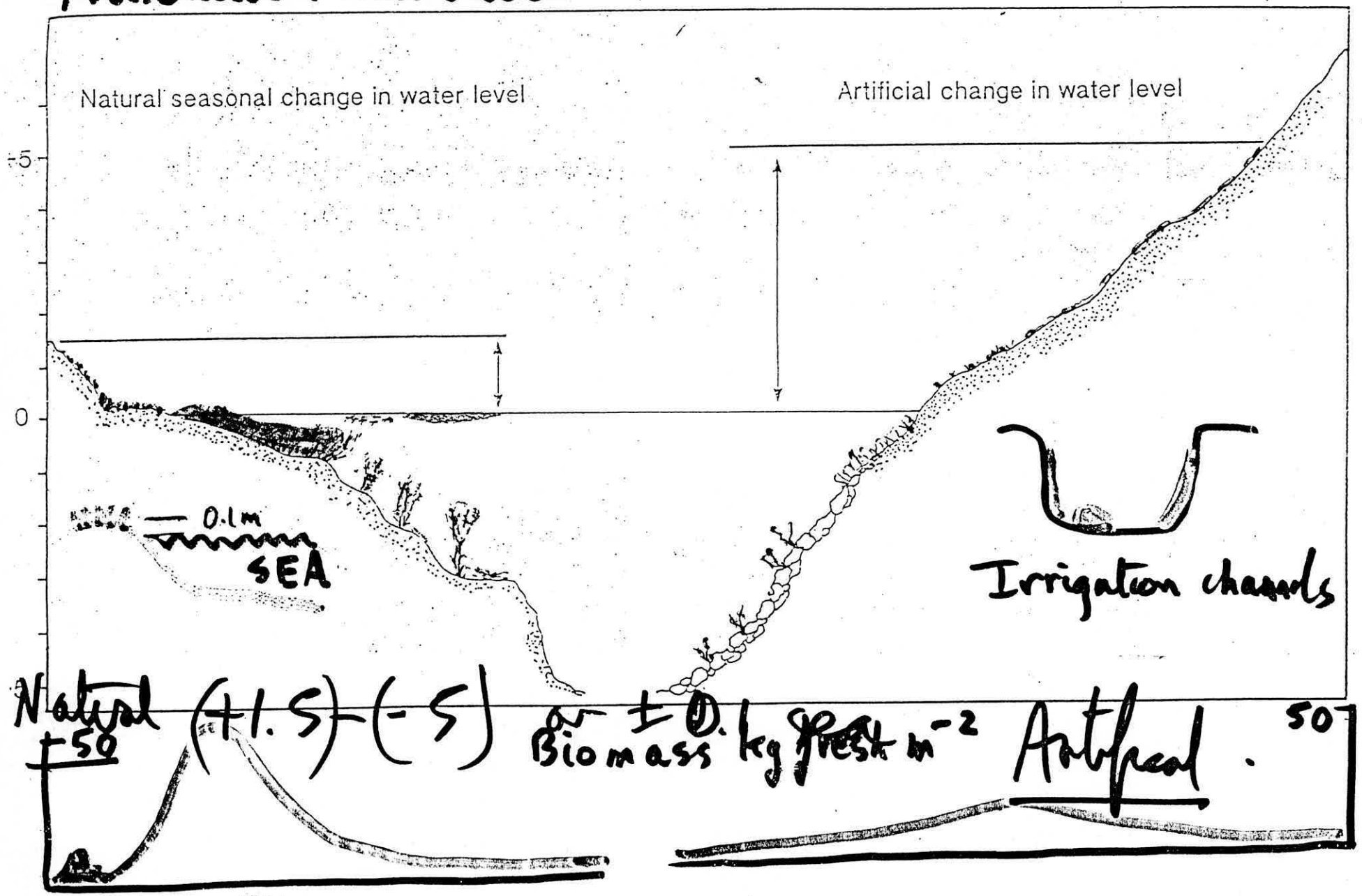
Guidelines - results of testing - reappraisal ?
- Test sites Corfe pond vs Inyslas

Reasons for the difficulties of its control
- Its ultra-competitive characters
- biomass control vs eradication

○ record

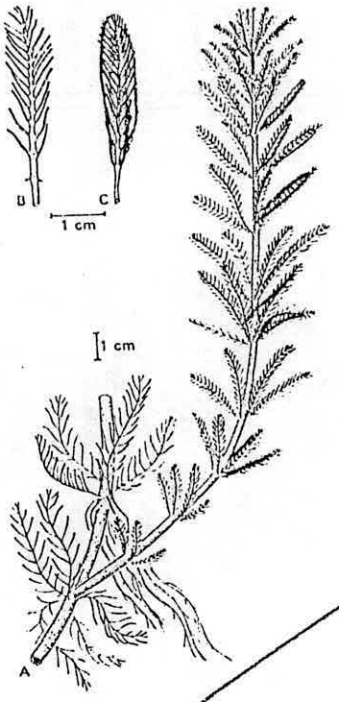
● confirmed record

Australian habitats

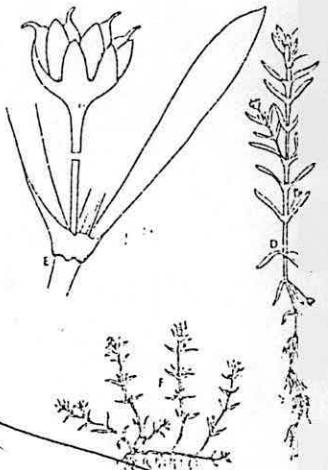


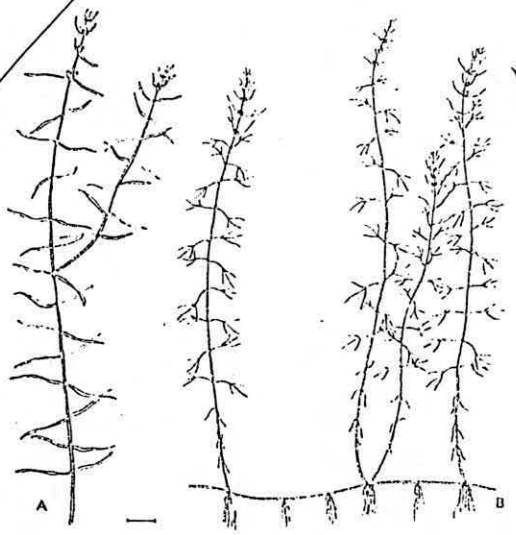
0114

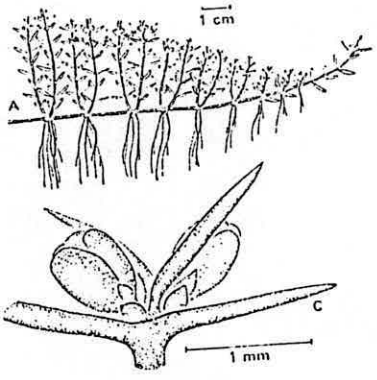
Alliance –
Myriophyllum
propinquum
variable & often
reduced

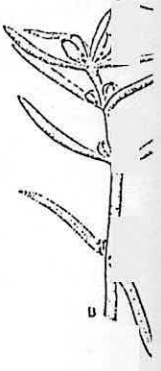


Crassula natans
var minus
from S. Africa

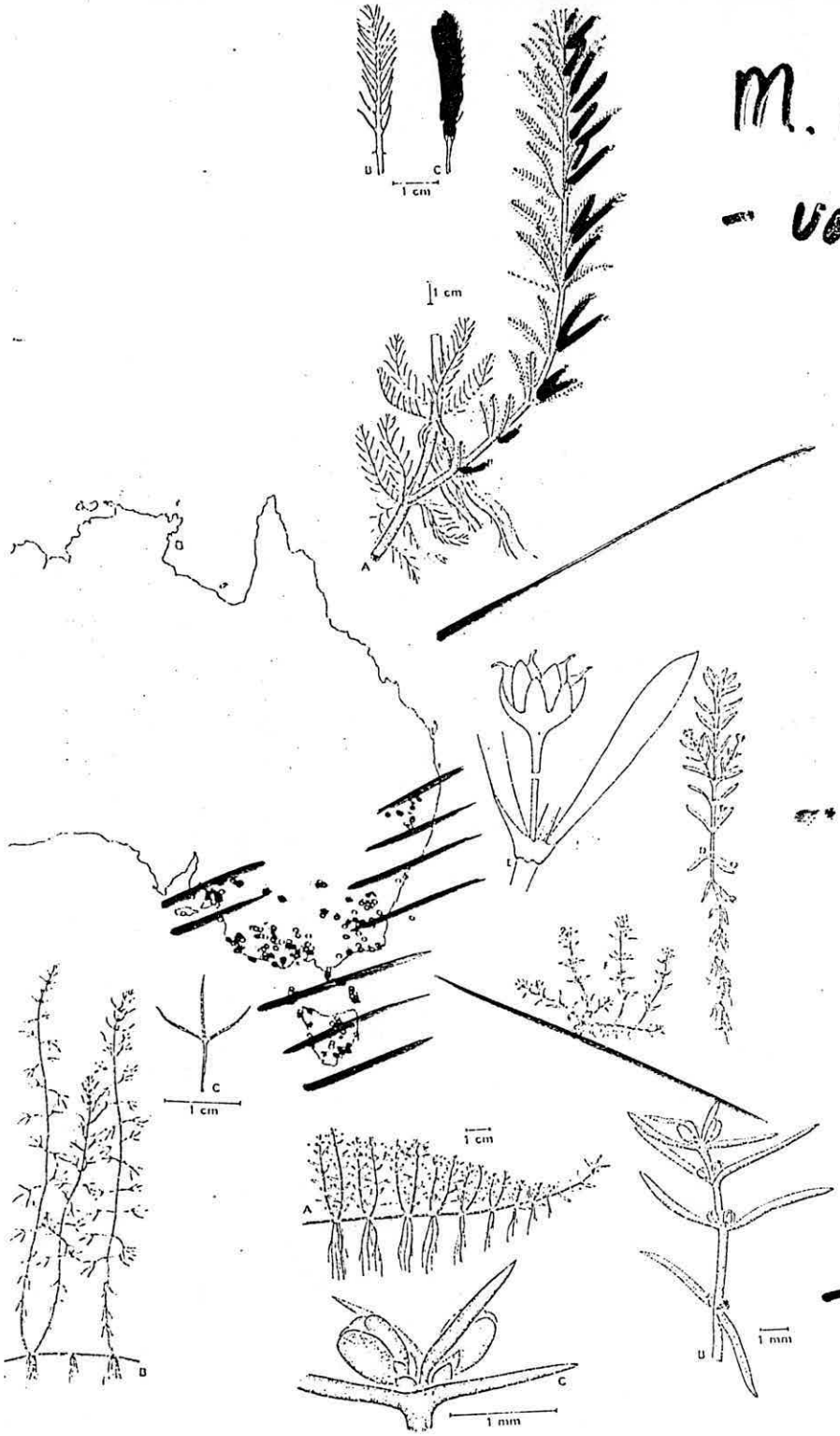








Myriophyllum pedunculatum
v/w var. longibracteolatum var ped..



M. propinquum all.
- variable, oft. reduced

C. kunzei
- amphibious

M. pedunculatum
- 'similar'
asymmetric tips
low biomass

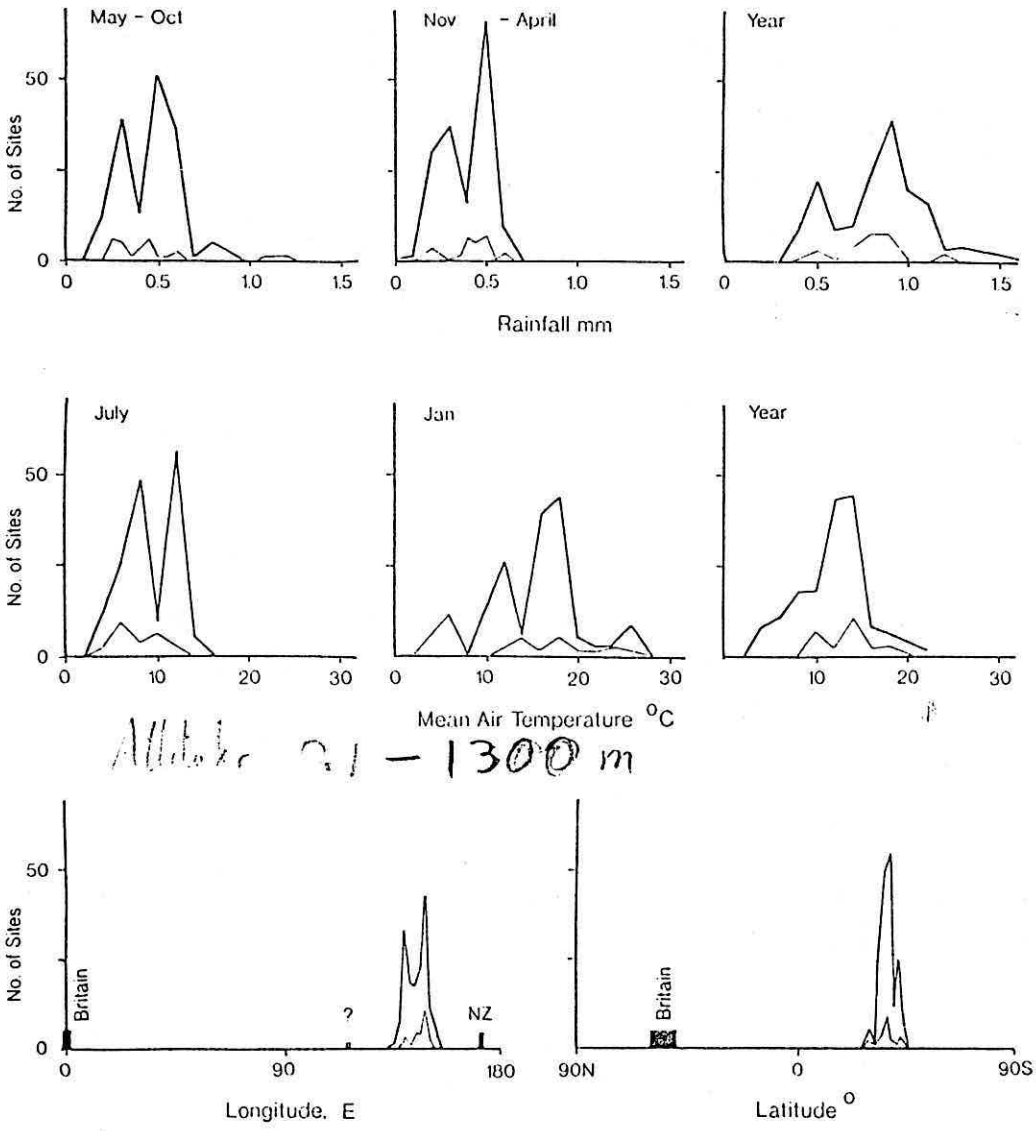
The distribution in Australia

Major differences between the climate in North Western Europe and the Southern hemispheres, make latitudinally based comparisons difficult. Thus broad correlations of climatic data were made between the plants native habitats in Australia and NW Europe (Fullard & Darby 1969). Analysis of the 161 previously recorded and the 45 sites of *C. helmsii* in Australia recently confirmed in 1989, indicate that the plant is found predominantly within the approximate range for:
(a) rainfall during
the summer period (November - April) of 0.1 - 0.55 m,
the winter period (May - October) of 0.2 - 0.65 m and
with an annual range of 0.4 - 1.15 m; and
(b) mean air temperatures
during the mid-summer month of January of 10 - 20°C or occasionally hotter,
during the mid-winter month of July of 4 - 14°C and
an annual range of (4) 8 - 16 °C.

The range within New Zealand although apparently much smaller, lies within the above.

In additional, analysis of data collected at the sites visited in 1989, indicate that the range of other factors vary as:

Although the effects of altitude particularly reduction in temperature is nominally covered within mean temperature data,
salt?



Altitude 21 – 1300 m

The distribution in Australia

Major differences between the climate in North Western Europe and the Southern hemispheres, make latitudinally based comparisons difficult. Thus broad correlations of climatic data were made between the plants native habitats in Australia and NW Europe (Fullard & Darby 1969). Analysis of the 161 previously recorded and the 45 sites of *C. helmsii* in Australia recently confirmed in 1989, indicate that the plant is found predominantly within the approximate range for:
(a) rainfall during
the summer period (November - April) of 0.1 - 0.55 m,
the winter period (May - October) of 0.2 - 0.65 m and
with an annual range of 0.4 - 1.15 m; and
(b) mean air temperatures
during the mid-summer month of January of 10 - 20°C or occasionally hotter,
during the mid-winter month of July of 4 - 14°C and
an annual range of (4) 8 - 16 °C.

The range within New Zealand although apparentlly much smaller, lies within the above.

In additional, analysis of data collected at the sites visited in 1989, indicate that the range of other factors vary as:

Although the effects of altitude particularly reductionn in temperature is nominally covered within mean temperature data,

	Aust range lower	mean	upper	Aus elevated & not/land	UK levels
Alkalinity - carbonate	0.1 - 1	- 2.6		.2 - 4.4	
Chloride	8 -		-2560	low - 300 +	
Colour	3 -		110	(8 - 145)	

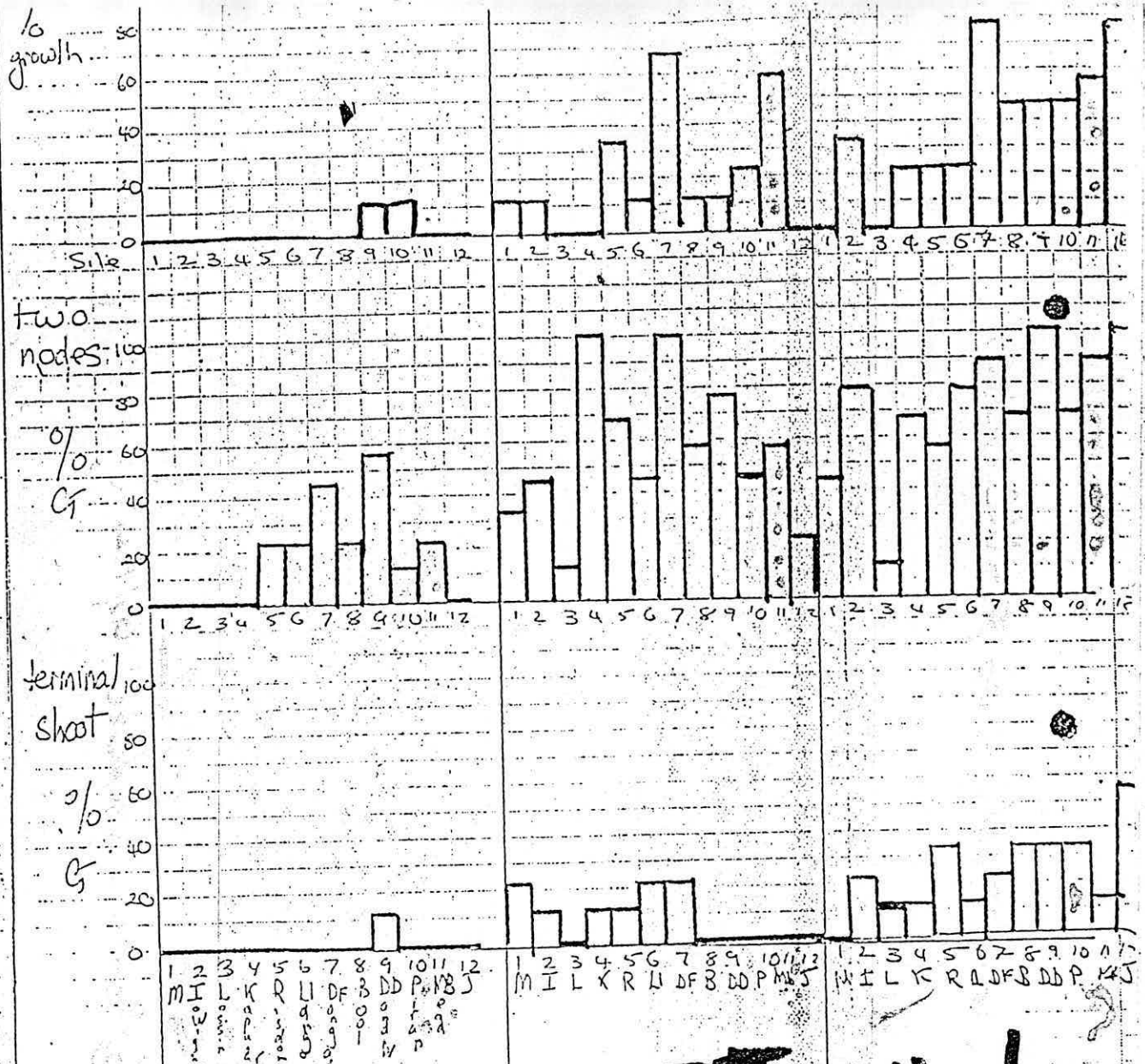
Phosphate 0 - (low) 50 (9000) µg
Nitrate 0 - (low) (10) mg/l

check EN report

OU.7

Water Chemistry - Australia

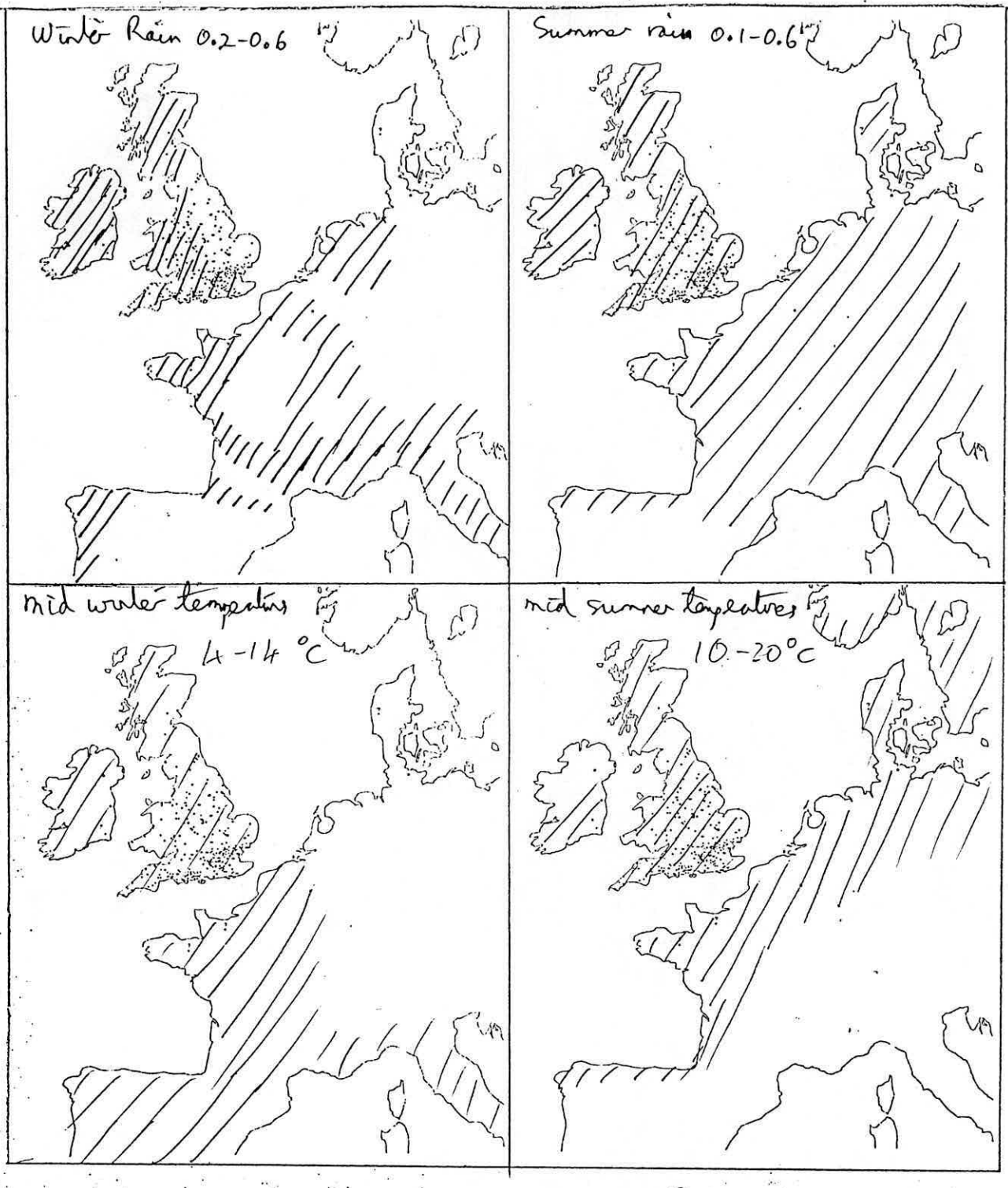
pH	Not @ 4.8	6.4 - 8 - 9.2	Not @ (9.4)
Conductivity µS		32-3100	
" mS, near		3 - 51	
Alkalinity $CO_3^=$		0.1 - 2.6	(4.4)
Calcium $mg\,l^{-1}$		3 - 110	
Chloride $mg\,l^{-1}$	low	8 - 2560	
Phosphate $\mu g\,l^{-1}$		~0 - 80 - 9000	
Nitrate $mg\,l^{-1}$		~0 - low - 10	
		low biomass	~ high biomass



with
M. BROCK
ARMIDALE, AUS

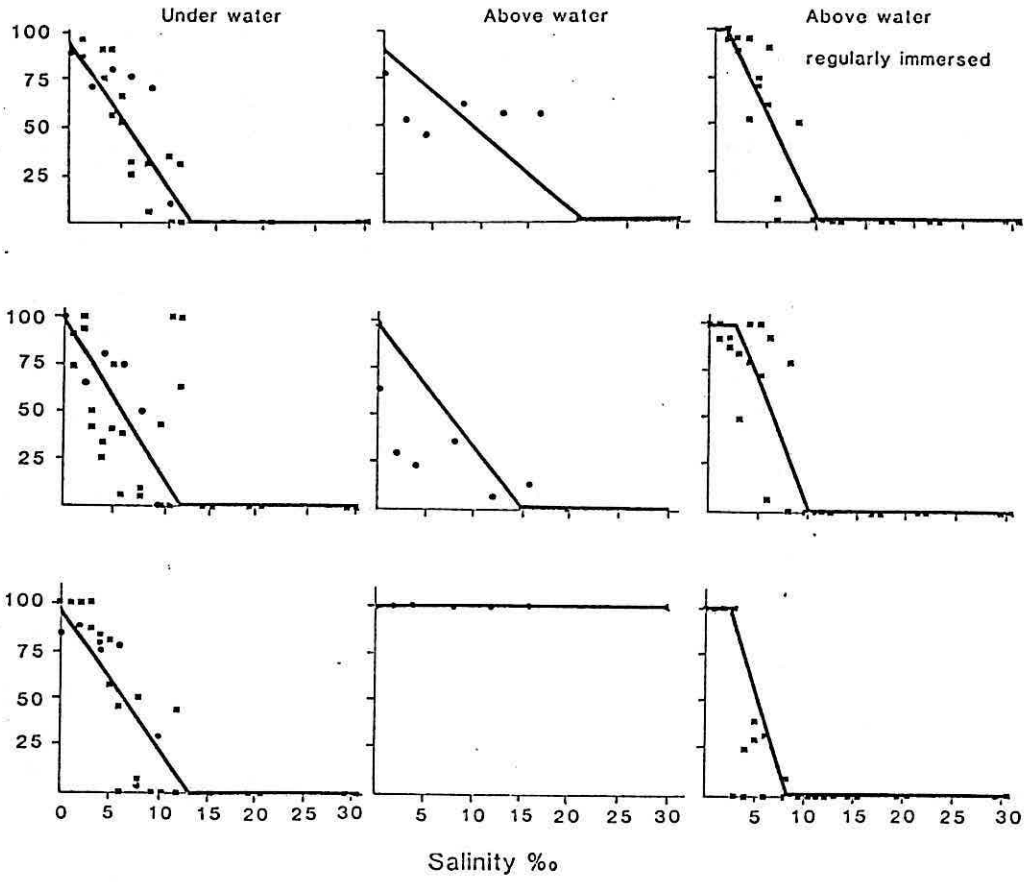
Prediction of distribution in NW Europe based from Climatic data for Australian habitat

temperature - min/max
rainfall
water chemistry -
    nutrient
    salinity
altitude

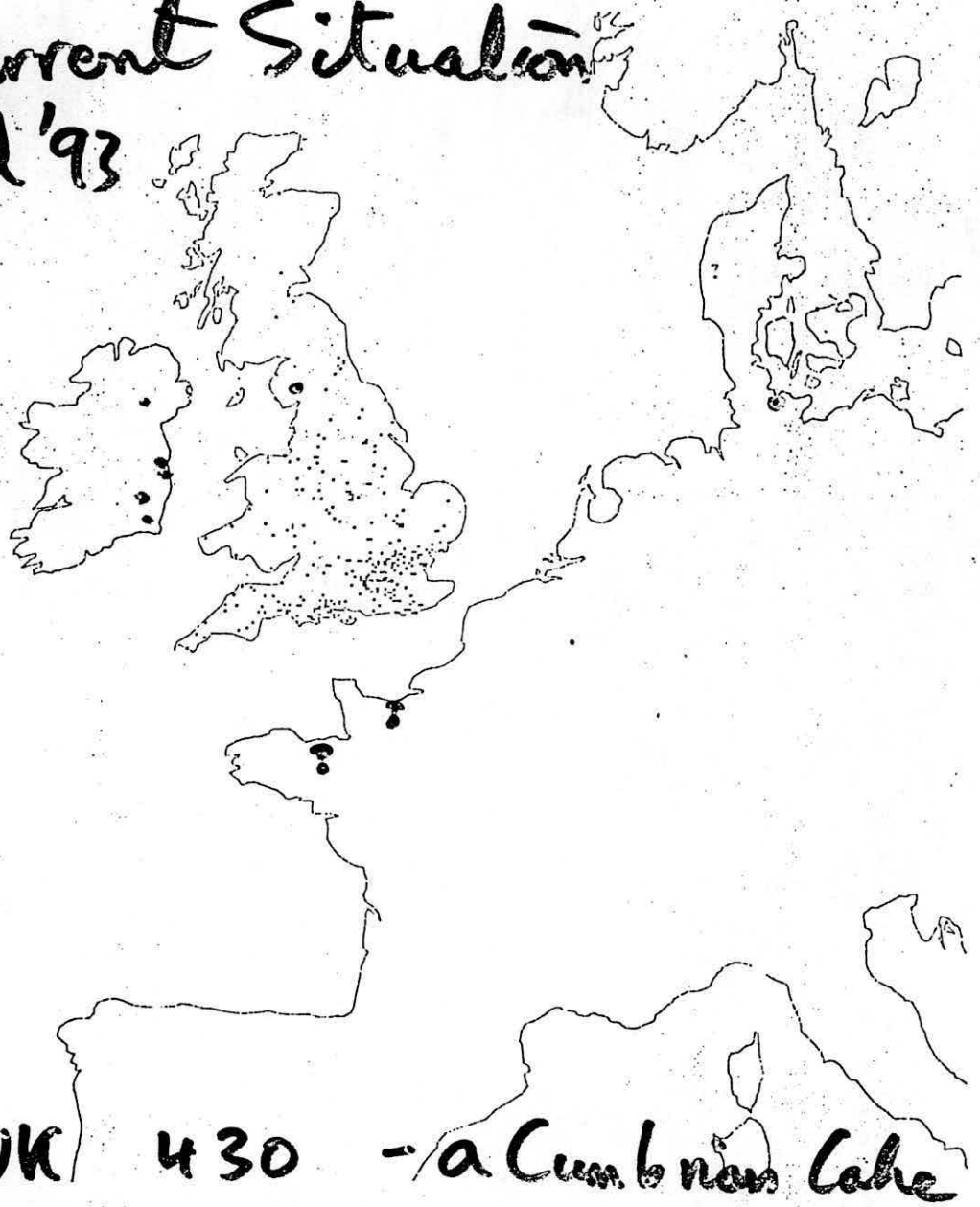

Winter Rain 0.2-0.6 in
Summer rain 0.1-0.6 in
mid winter temperatures
4-14 °C
mid summer temperatures
10-20°C

ON 8

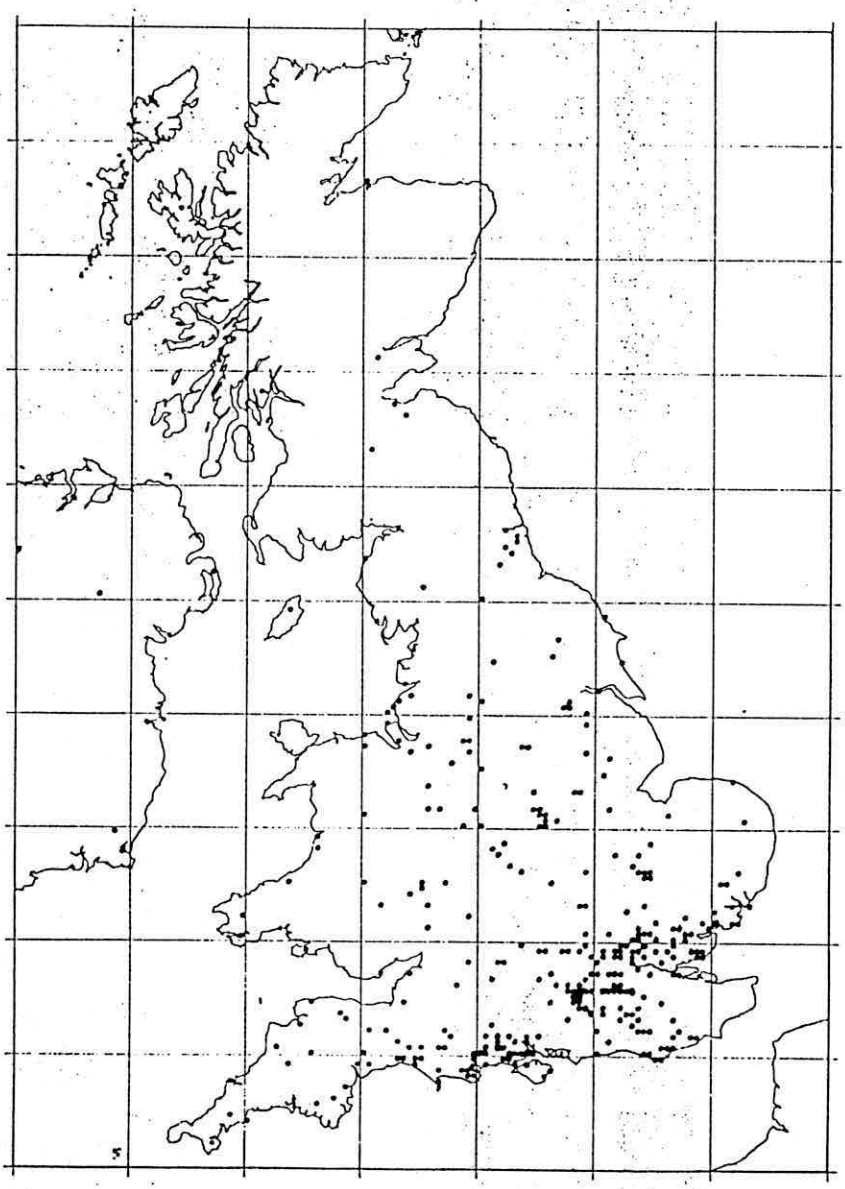
Salinity tolerance of shoots, •after 15 days ▪after 37 days



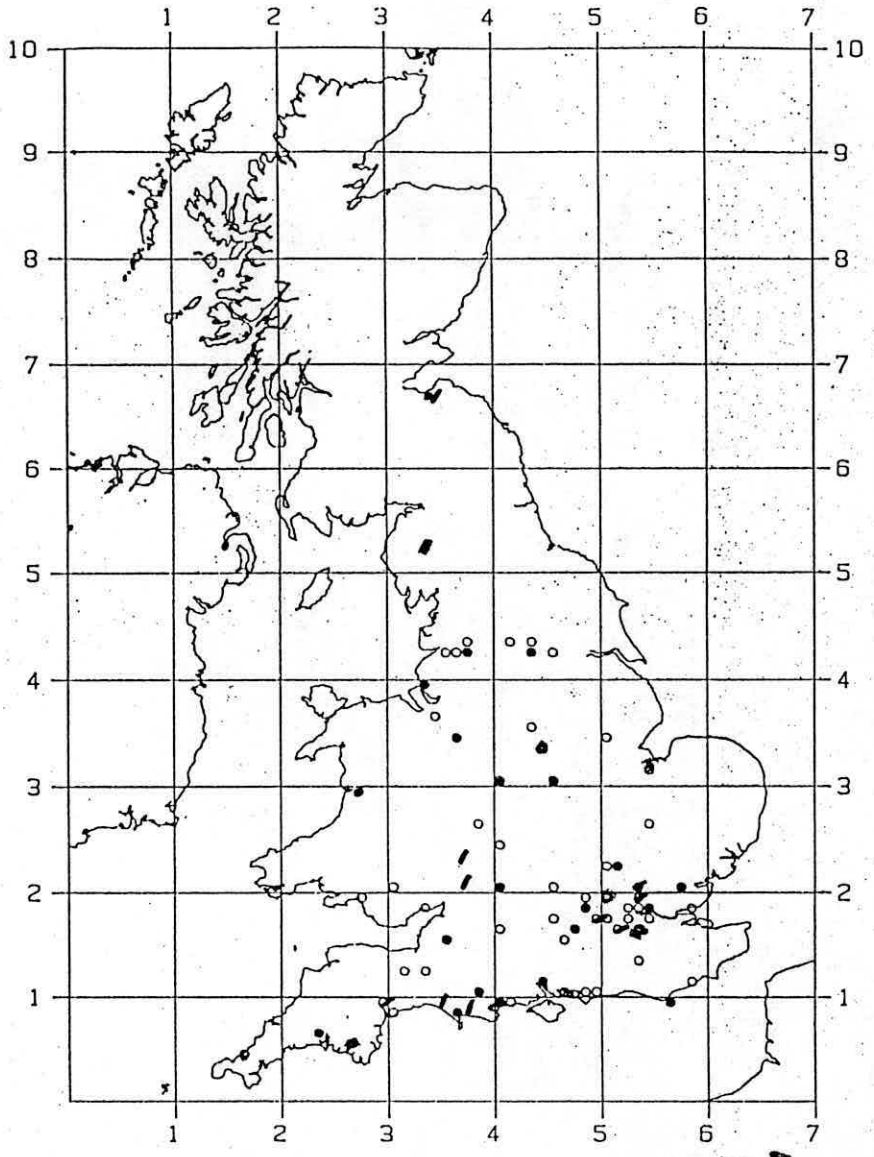
Current Situation mid '93



UK 430 - a Cumbrian Cake
IRL ?
B ✓
G ✓
F ?



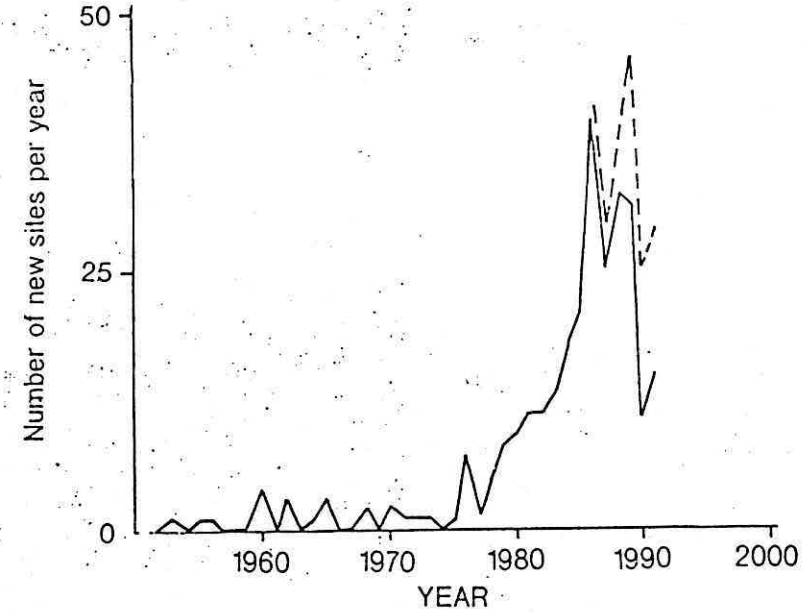
UK. - mainly man from aquatic suppliers for ornamental lakes/ponds (eg France grease/algae turbid pools)

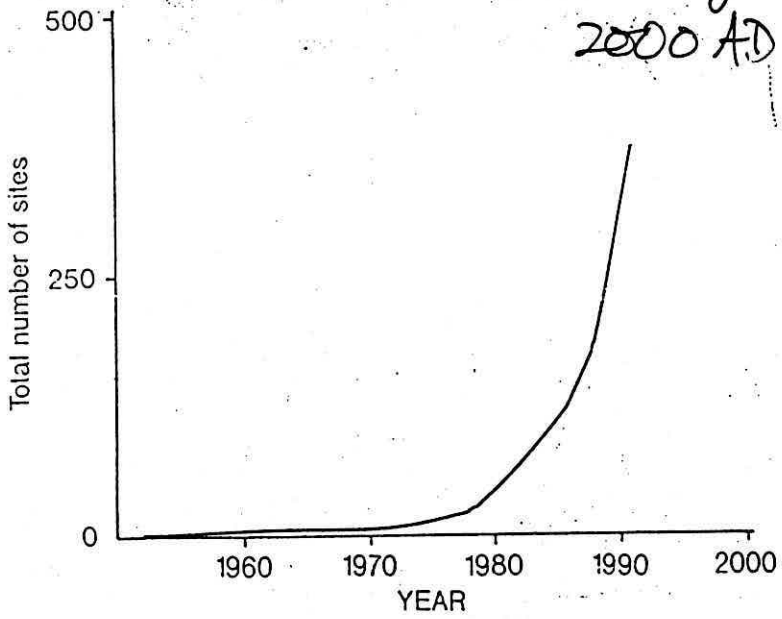


• Confirmed suppliers

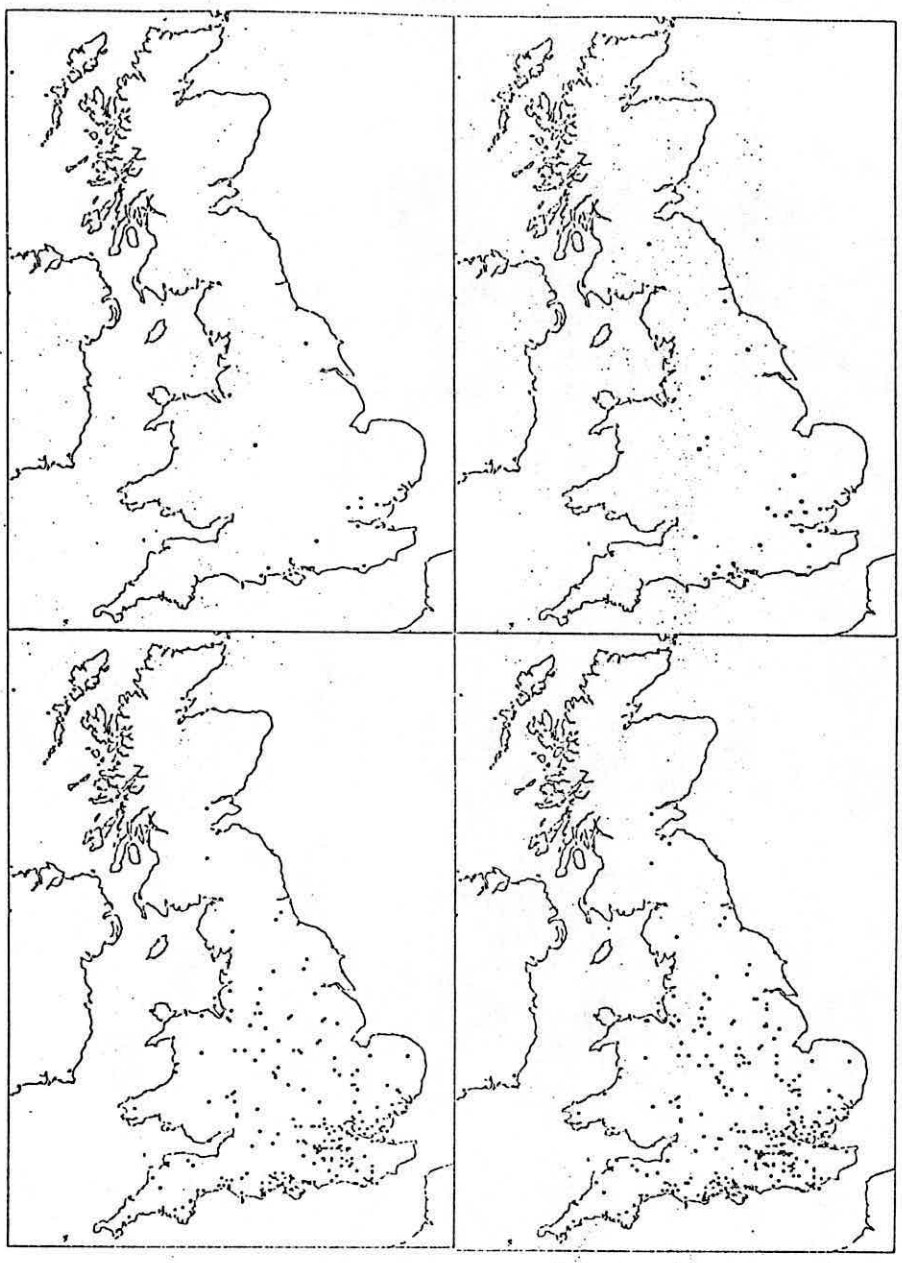
o Potential suppliers

Indirect only

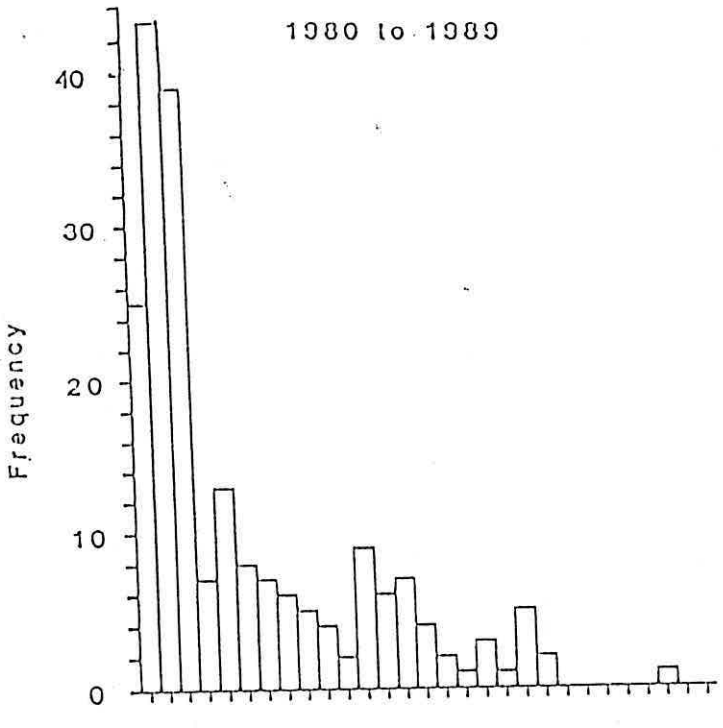


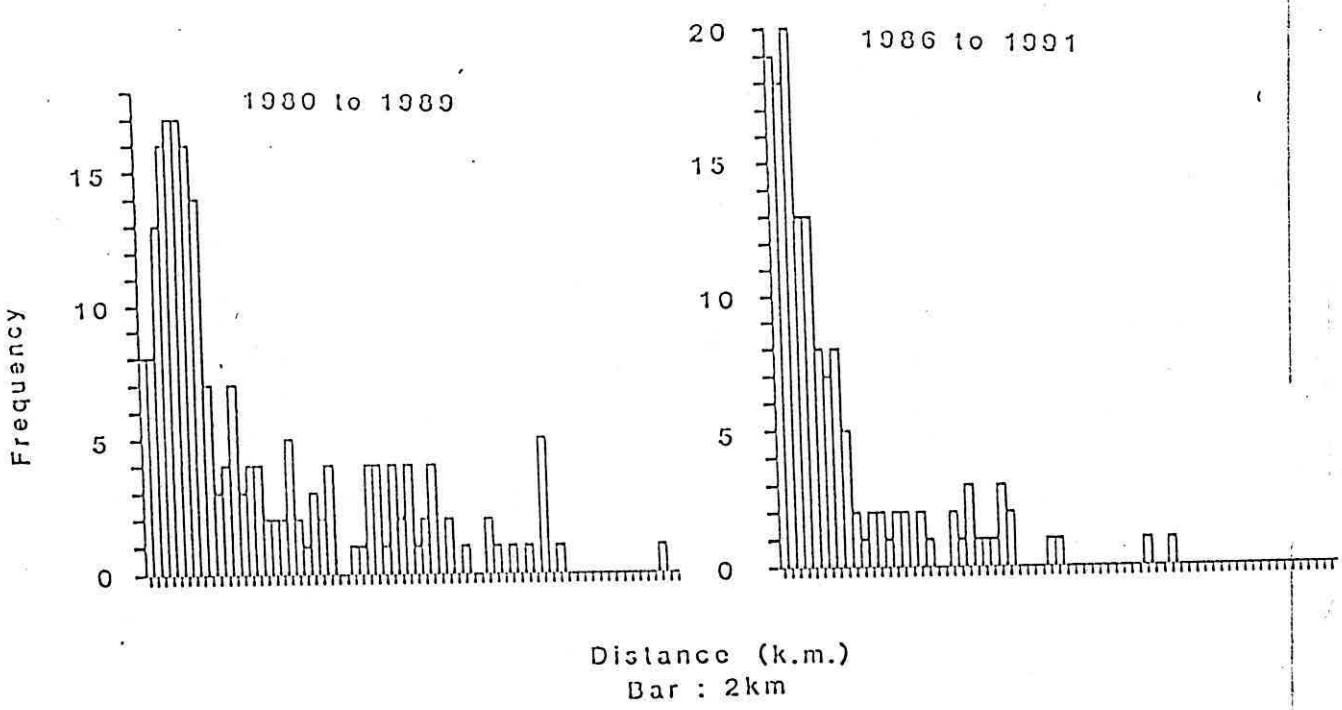


1000 + by
2000 A.D

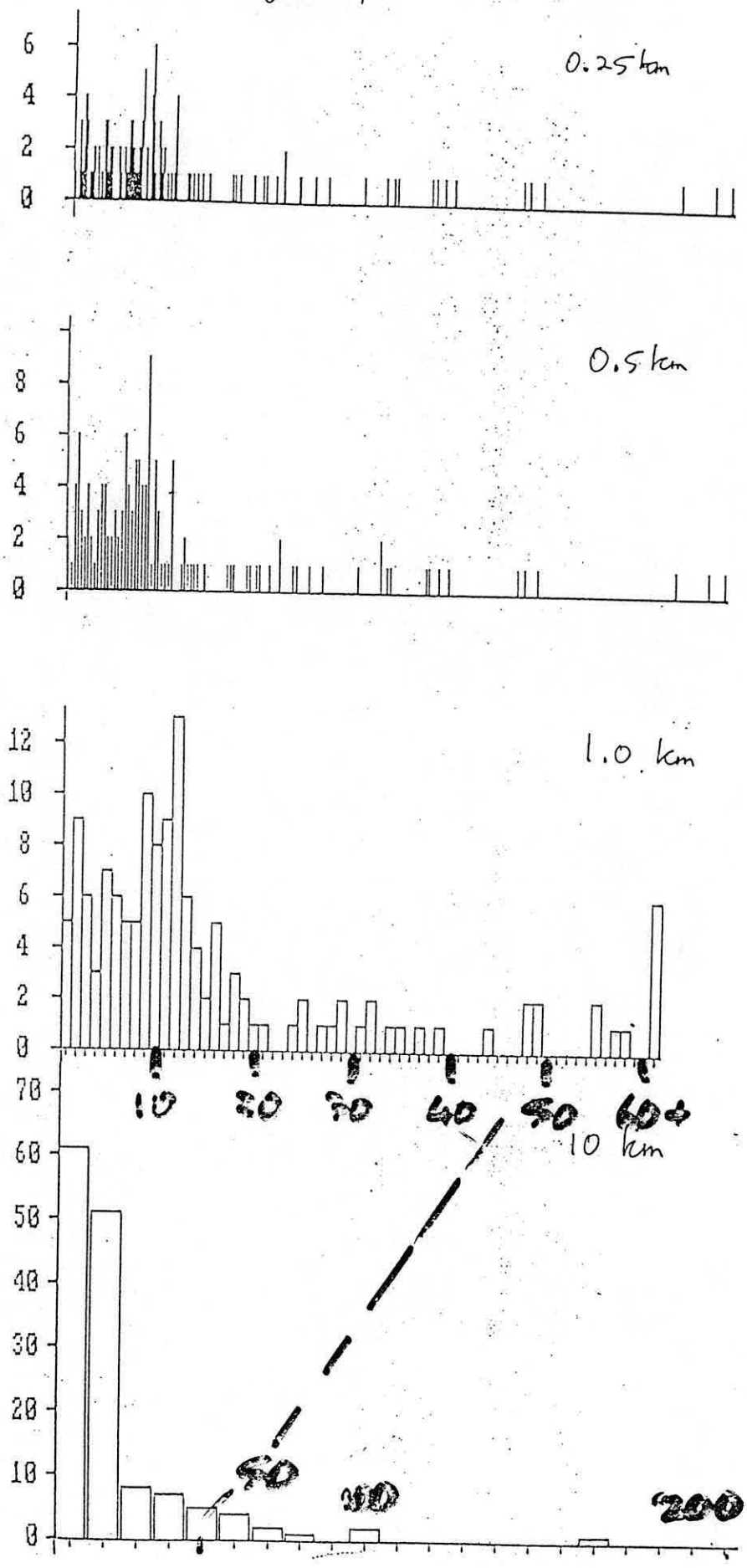


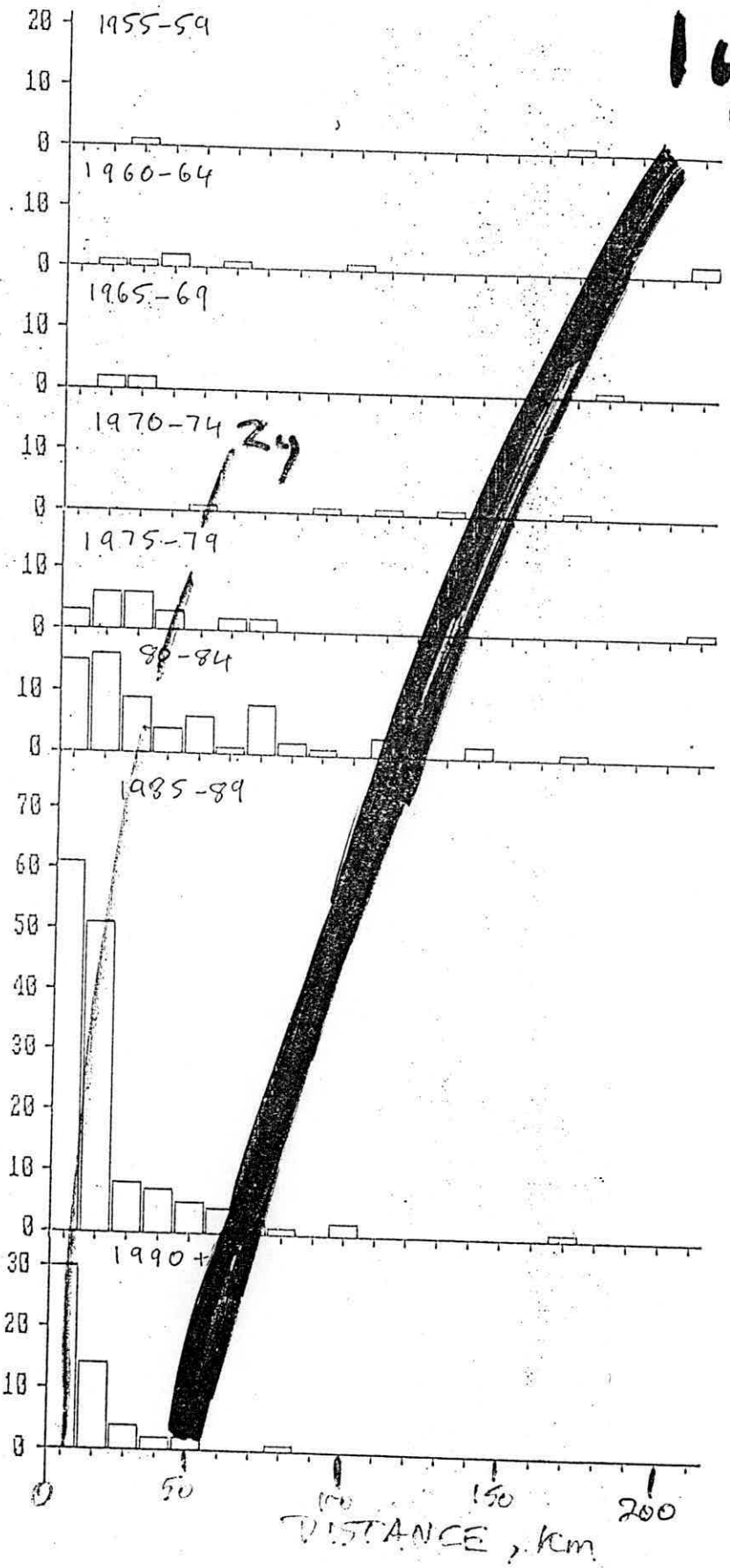
movement of C. helmsii





Histograms of distance from previous sites within 5 year period 1985-1989




1955-59
1960-64
1965-69
1970-74
1975-79
80-84
1985-89
1990+
20
10
0
30
70
60
50
40
0
50
100
150
200
DISTANCE, km

Reasons for the difficulties of its control

Its ultra-competitive characters

Traditionally chemical and physical ie hand or machine removal, have been aimed strictly at reducing the presence of problem vegetation, not eliminating the species which is required for this plant. There are consequences of this
1. very difficult to undertake physically as biomasses reach 25 kg m^{-2} fresh weight in water depths to 2 m, and would require removal and safe storage or processing of probably even larger quantities of sediment containing shoot or root fragments.

2. chemical control has also been adjusted to severely reduce but not eliminate plant populations; thus there is an acceptable herbicide to plant biomass ratio but unfortunately this seems to be exceeded by both the normally accepted criteria for herbicides which act on photosynthetic mechanisms
both ie that herbicide to area of action eg diquat on photosynthetic mechanism for the plants have a high areal chlorophyll value and do not cease activity during the winter, and by those which act on growing areas such as shoot tips such as (
and also by direct acting herbicidal compounds)

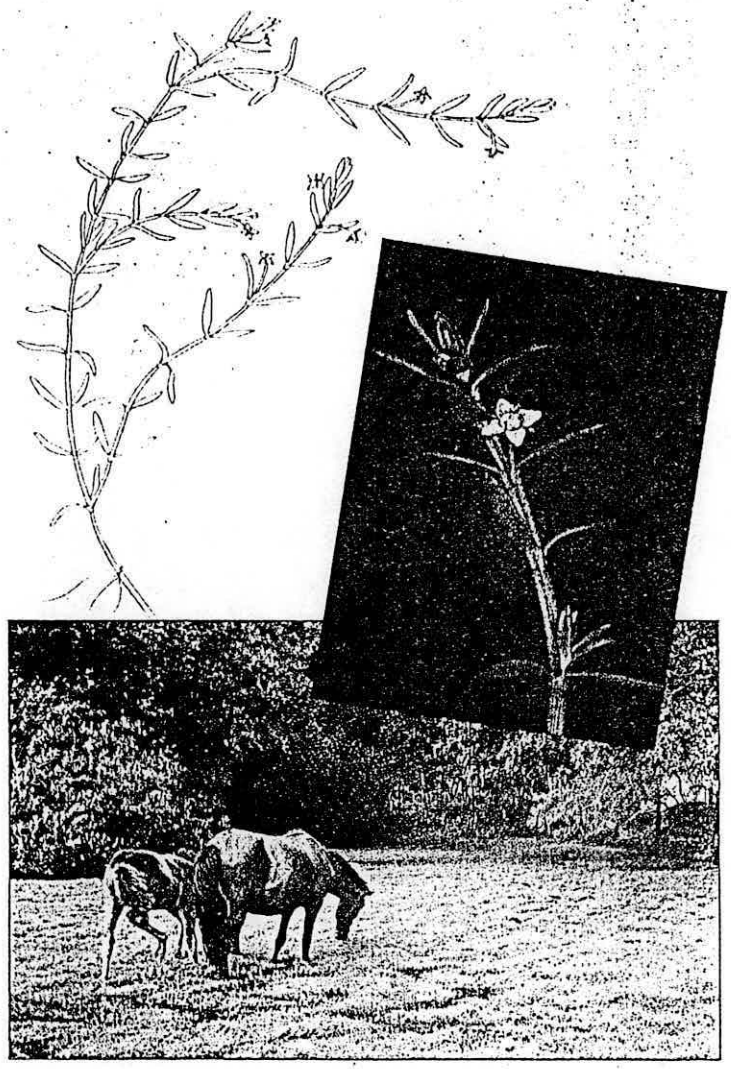
by having many shoots per unit biomass,
accumulating a thick layer of organic material which can absorb herbicides
with large number of still viable axillary buds
non-cessation of seasonal growth
die back to tips protected by leaf layers not away from tips

(I intend to present more detailed result at the EWRS Conference in Ireland in 1994 on the ratio of plant biomass to herbicide for this species)

ENGLISH NATURE

Institute of Freshwater Ecology

Crassula helmsii
Focus on control



Natural Environment Research Council

As a result it was clear that whilst it was easy to specify control methods for submerged forms, further work was required to produce workable methods for emergent forms.

The following guidelines are based on the findings of this work, and will be updated in the light of new information.

Small areas - up to areas of 20 m^2 or larger (ie up to 400 m^2, if a drying turf)

Cover with an opaque material eg geotextile, black polythene, rick sheet, old carpet etc, for 6-10 weeks as soon as possible following identification of plant. Such material may require to be weighted at corners and elsewhere to keep it in position. Alternatively 'spot' treatment with herbicides as below.

Medium sized areas - 20 to 1000 m^{-2}

Consider herbicide application. Diquat alginate (available commercially as 'Midstream') for submerged forms. Glyphosate (available commercially as 'Roundup') for emergent forms and drying turves.

Diquat alginate

Apply to water at the rate specified on the label (ie 0.5 litre per 100 m^2 if less than 0.3 m in depth or 1 litre per 100 m^2 if greater than 0.3 m). The herbicide can be used at any time, but avoid times when the water is turbid.

Glyphosate

Apply to vegetation at the rate specified on the label (ie 5 litres per ha of Roundup).
N.B. 0.5-2% of Mixture B should also be added to improve performance. Apply when plants are actively growing with a full emergence, ie any time from flowering through to dieback stage.

Note. Other Approved aquatic herbicides are less or not effective and should be avoided (asulam, 2,4-D amine, dalapon, dichlobenil and terbutryne).

Any sections of the pond or margins which are to be sprayed should be enclosed by a fence of fine wire mesh to that any area of about twice that of the plant stand is enclosed. This will prevent small pieces of shoot released following herbicide application from being spread around 'infecting' the pond. This area should be monitored before removal of the fence or before any re-application of herbicide (possibly to a significantly decreased area).

Large areas - greater than 2000 m^{-2} or 25% of water body as margin or area

1. Remove as much *C. helmsii* to bank as possible, stack and compost under a secured light-proof cover eg rick sheet, 20 cm of soil close to the site.

   - **do not transport material from affected site.**

2. Then apply herbicide, as above.
3. Monitor 6 monthly and reapply herbicides to (possibly reduced) areas of regrowth of *C. helmsii.*

4. Re-introduce native flora from unaffected part of water body or adjacent areas.

The time of application of the herbicide may be adjusted to suit regrowth of local flora from rhizomes or seeds (see herbicide label). However it should be noted that although normal application in accordance with the label is legally acceptable fro diquat-alginate through the autumn, it is only legal until mid September for glyphosate. However as *C. helmsii* continues 'active growth' during this period and for the majority of the year 'off label use' may need to be considered. Care must be taken to avoid causing the death of autumn germinating seedlings of some temporary pool plant species which then rest overwinter before active spring growth.

A balance must also be determined between the use of the more effective herbicide recommended for underwater use (diquat) *versus* the reduced dispersion of that recommended for use on emergent stands of *C. helmsii* (glyphosate) during times of maintained high or low water level.

GENERAL POINTS, APPLICABLE TO ALL AREAS

Remove fragments from boots and other equipment before leaving a site. All treated areas must be monitored by carefully examining several small areas for developing shoots or small buried rhizomes, looking both within the area previously occupied by the plant and within adjacent areas. Monitoring should be continued at quarterly intervals for up to 5 years following apparent elimination of *C. helmsii* (no elimination has so far been successful).

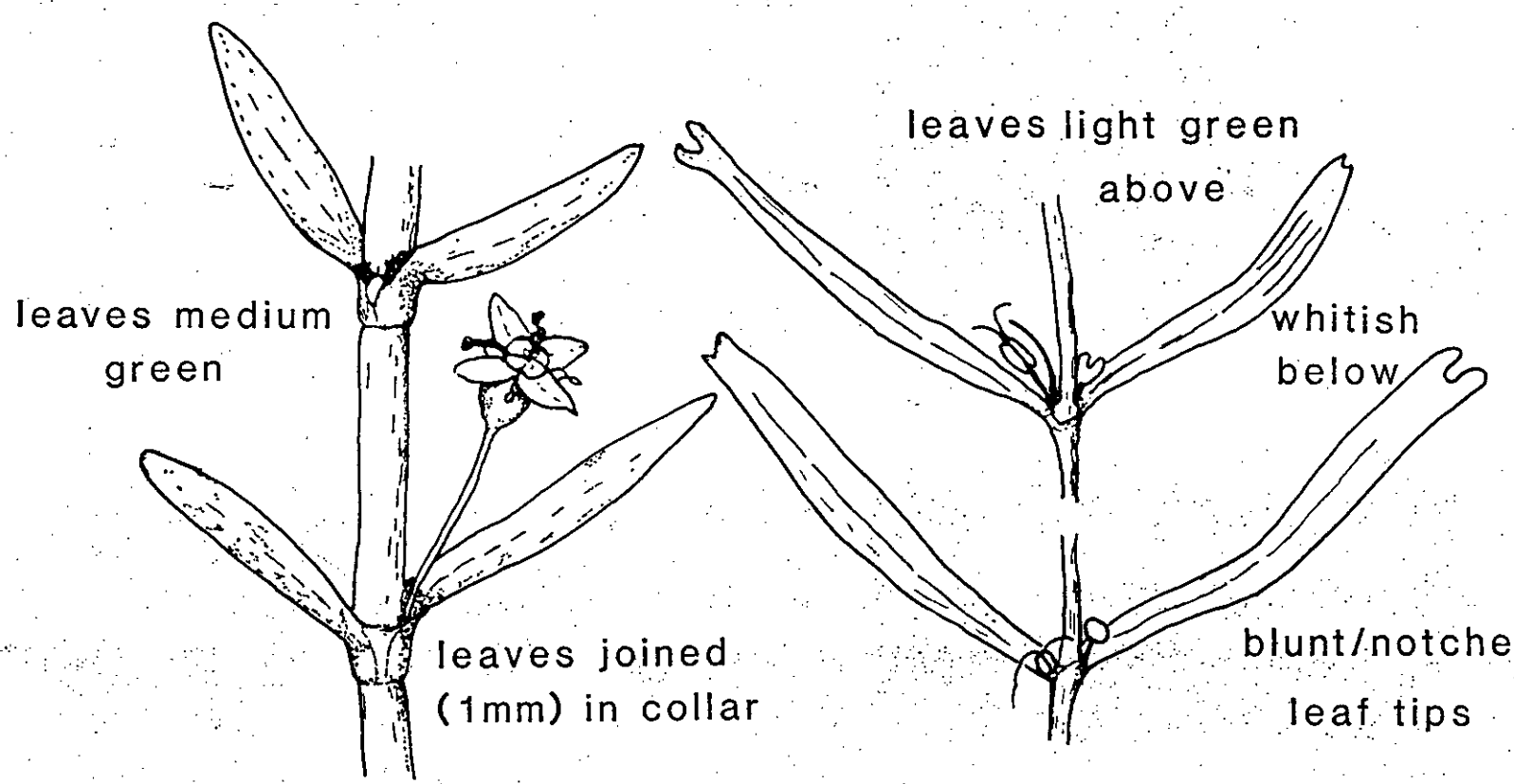
Note. Pesticides may only legally be applied by operators, or by persons in their direct control, who have an appropriate certificate of competence issued by the National Proficiency Test Council for Agriculture and Horticulture, under the Control of Pesticide Regulations, 1986 and in accordance with the appropriate Code of Practice under Food and Environmental Protection Act 1985, to avoid complications involving ownership and control of the land.

Future

An important element in the success against *C. helmsii* will depend on the recording and monitoring of the spread, and of attempts to eradicate it. It is therefore important that any new occurrences are registered with either the IFE or BRC and that any observations regarding control methods are reported.

HOW TO TELL

'SWAMP STONECROP FROM A STARWORT'



Leaves can emerge from water

Flowers above water

Rigid stem

Leaves below water never above 'flowers' below water

GLAUX MARITIMA

Options suggested

Small areas / ponds

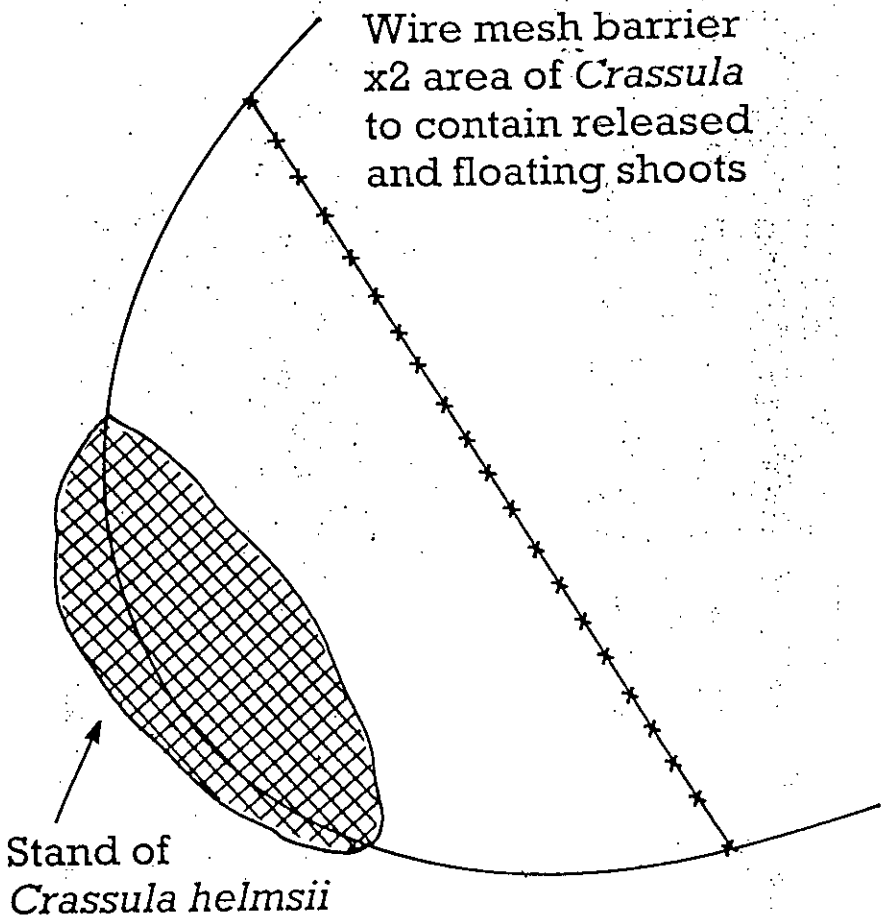
1. Opaque sheeting
2. reduce bulk
   + then herbicides

Small area in large pond

as (1)

or (2) but enclose area
   to contain fragments
   + herbicides
   + spot treat

Check regularly


Wire mesh barrier
x2 area of *Crassula*
to contain released
and floating shoots
Stand of
Crassula helmsii

result of testing of guidelines - reappraisal necessary?

The traditional objection to herbicide treatment is loss of desirable species and accentuation ie maintaining dominance of dominant species that is the species requiring control or change of problem such as to an algal dominated situation, and this in combination with known extreme herbicide resistance of *C. helmsii* suggested alternative approaches particularly in timing.

Example of less usual choice of timing ie February justified as *C. helmsii* is still green and probably growing or at least redistributing material if not increasing in biomass.

contrast here or above to Ynyslas early control results

Test site 1.

A shallow seasonal pond, Higher pond, Corfe Castle, Dorset, (owned by The National Trust) with a few bushes of *Salix* spp., located in 'common land' grazed by ponies & cattle and at the end of the town with easy access for many people. The maximum water depth in winter is 0.4 m but the pond dries to <0.1 m by late summer. The submerged and emergent vegetation layer of the pond was dominated by *C. helmsii* in 1986. This invasion probably caused a further significant reduction in the numbers of plant species present which may also have resulted from increased grazing since the 1930s.
The recommended control from the pamphlet was the removal and on-site composting or the use of shade-material, followed by herbicide applications. However, as it was considered locally that plant species could be lost with the *C. helmsii* material removed, it was agreed that herbicides would be used following the enclosure of the area to prevent any potential poisoning of the grazing animals; the non-removal of material was not considered of particular consequence as the biomass was only 1 - 1.5 kg m^{-2}.

Treatment started in February, 1991 with treatments of diquat-alginate and glyphosate with adjuvent. When surveyed three months later the majority of the submerged *C. helmsii* was killed but some of the emergent stands remained.
The treatment was repeated in February 1992 after which no submerged *C. helmsii* remained but when assessed in mid-March, there were some stands of emergent *C. helmsii* on one side.
In 1993, the few remaining patches of emergent *C. helmsii* were spot-treated with diquat

Table . A comparison of aquatic, bank and submerged flora for Higher Pond, Corfe, before and after invasion by C.helmsii (1936 by R. Good; 1982 = part of list A.E. Newton & I. Cross, Dorset Environmental Record Centre, pers. comm.; 1986 = F.H. Dawson & E. Warman; 1993 = D.F. Westlake, pers. comm., Key x = present; - = absent but searched for; ? = identification uncertain; ( ) = not previously classed as aquatic)

	1936	1982 pre *Crassula helmsii*	1986 peak	1993 post x5 herbicide
	OPEN	OVER GRAZED	UN-FENCED	FENCED
(Agrostis stolonifera)				x
Alisma plantago-aquatica	x		x	
Anagallis tenella	x			
Apium nodiflorum	x	x		seedlings?
Baldellia ranunculoides	x	x	x?	x
Bryophytes	2			
Callitriche agg.	x	x		
C. obtusangula			x	seedlings
C. stagnalis			x	seedlings
Caltha palustris	x			x
Crassula helmsii			***	(? fhd)
Eleocharis palustris				x
Equisetum palustre(?)			x	x
(Eupatorium cannabinum)				x
Galium palustre				x
Glyceria fluitans	x		x	x
Groenlandia (densa?)			x	
Hydrocotyle vulgaris	x	x		x
Hypericum eloides	x	x		
Iris pseudacorus				x
Juncus articulata	x	x		x
J. bufonius	x	x		
J. bulbosus	x	x		
J. effusus	x	x		x
Lemna minor			x	x
Lythrum portula	x		x	
Mentha aquatica	x	x		x
Menyanthes trifoliatus	x			
Nymphaea sp.(alba?)				x
Phalaris arundinacea				x
Potamogeton natans			?	-
P. polygonifolius	x			x
Ranunculus (aquatilis?)			x	
R. flammula	x	x		x
R. hederaceus			?	
R. lingua				x
Sparganium erectum	x			-
Sphagnum spp.		x		-
(Stellaria alsine)				x
Triglochin palustris	x			
Veronica anagallis-aquatica	x			-
No. aquatic species	**21**	**12**	**7/12**	**20**
% original	**100**	**51**	**33-57**	**96**
% change		-49	-66	-4

Small pond, Ynyslas Dunes, Dyfi National Nature Reserve,
River Dovey Estuary
Visited 23.8.1988
Owner: NCC
Contact: Paul Burnham, Reserve Warden
First recorded 1986

(i) Paul Burnham reports:

'Crassula helmsii was found growing in 1986 in a small pond (and later in adjacent ditches), approximately 18 m x 6 m, situated in the eastern dune slacks. This pond had been excavated in 1978 to retain an area of open water during the summer period. In the winter months the pond fills with water and joins up with the flooded dune slacks creating a potentially larger area for the plant to colonize.'

Glyphosate was used to spot treat (21.9.87) C.helmsii on the northern bank of the pond (1-1.5 x 18 m). A month later (19.10.87) and with falling water levels, a clear division was observable between the dead plant material previously out of water and that previously in the water; this clear division did not seem to apply to plants in the shade of willow bushes. Diquat alginate was then applied (19.10.87) but although much was killed, floating and viable (?) fragments were still present in the pond. A further treatment was made in winter which killed almost all the remaining C.helmsii although very careful examination yielded a few diminutive live shoots.

(ii) C. helmsii was effectively controlled in the adjacent ditches by using weighted sheets of black polythene to cover the plants for several months.

Source of plant unknown, but 11 miles downstream of aquatic centre with C.helmsii but line of sites near or suggests introduction by man and/or followed by spread during winter flooding of dune slacks (the plant is known to have a tolerance to half sea water).

Status: probably eliminated, but requires monitoring at least still twice more, Spring 1989, Autumn 1989.

Reappeared 1992? recorded by visiting county botanical recorder probably not monitored due to change in warden!

Table 6. The biomass of *C. helmsii* in December 1988, June 1989 and October 1990, following tank trials of the application of Approved herbicides and herbicidal chemicals.

	Autumn Trial 1988			Late Spring Trial 1989					Autumn Trial 1990			
	post-treatment, December			pre-treatment (July)	post-treatment (August)				Post treatment			
Emergent	fresh wt kg	dry wt kg	reduction %	fresh wt kg	fresh wt kg	dry wt kg	change in weight actual %	change in weight growth corrected %	fresh wt kg	dry wt kg	reduction fresh wt %	reduction dry wt %**
asulam	3.2	.22	66	5.5	6.0	.61	+9	-3				
2,4-D amine	6.0	.29	55	2.8	3.0	.30	+7	-4				
dalapon	5.9	.32	51	4.4	4.9	.51	+11	-1				
glyphosate dose												
x1	1.6	.12	82	5.7	5.6	.60	-2	-14	17.5	.86	-25	-31
x3				7.1	6.4	.71	-11	-20				
x5									7.5	.44	-68	-65
x10									9.8	.52	-58	-58
hydrogen peroxide												
20 g m^{-2}	10.6	.77	n.e.									
100 g m^{-2}	8.9	.56	n.e.									
250 g m^{-2}	-	-	-	6.2	5.4	.61	-13	-24				
Untreated control	9.3	.65	0	7.2	8.2	1.19	+14	n.e.	23.3	-	0	0
Submerged												
dichlobenil	1.6	.10	66	2.8	1.0	.11	-65	-20				
diquat	0	0	100	3.7	0.5	.11	-86	-72				
diquat alginate a	0.1	.01	97	2.0	0.2	.02	-90	-80				
b	-	-	-	4.6	0.1	.01	-97	-95				
terbutryne	2.6	.15	48	1.9	0.75	.07	-60	-18				
hydrogen peroxide												
20 g m^{-2}	3.9	.24	n.e.	-	-		-	-				
100 g m^{-2}	4.0	.32	n.e.	-	-		-	-				
250 g m^{-2}	-	-	-	2.8	1.95	.18	-30	+45				
Untreated control	4.7	.29	0	2.5	1.2	.13	-48	0				

Key n.e. no effect

* The pretreatment weighing adversely affected the growth of submerged plant stands.

** assumes a 0.053 ratio of fresh to dry weight for the untreated control.

Trials in field and in tanks emphasised the problems of failure in some areas including:

1. high shoot number

2. high biomasses - previously the original tank trials were undertaken on biomasses around 4 kg fresh weight (2-10 kg) which allowed the efficacy of different Approved herbicides to be compared; the biomasses used were typical of submerged stands and newly invaded or mixed stands. However further field surveys determining biomass showed that mature marginal stands may reach several times this level. Trials were set-up in 1992 in dark-sided tanks with more realistic biomasses of 17 - 35 kg m^{-2} fresh weight which were achieved by allowing one years growth before treatment; initial results have produced little control in terms of biomass and its reduction or breakdown, despite the use elevated levels of glyphosate with adjuvent and diquat at low and high dilutions. Plants stands were in general severely affected especially at their upper surfaces but regrowth even under the highest and most dispersed treatment with diquat did not achieve full control.

Cost of treating british ponds with herbicide and cost of effort. Say 500 natural sites ponds of 10 m2 to 2 ha of 2.5 times area of herbicide (impossible for lakes eg Derwent water in Cumbria), five visits each plus further 6-monthly monitoring

high shoot density - 2 shoot/node 10-20 in apex

	stem/m²	stem length mm	internode = NODES
Colonisation - prostrate	2-400	150-250	(3)+5-10-(20) = 12-40,000
Stand - emergent /erect	15-30,000 tips		300 + (1-3) 5-10 (15-20) = 1-3,600,000
Submerged @ 2 m rosette + erect	1-200 + 400	150-250 ~1400	(1-2)-10-20 (-30) day. = 6-50,000
TURIONS - free floating			(1-2)

High Biomass kg fresh m^{-2}

initial measure field

3-45 kg fresh wt m^{-2}

Herb. tank trials 1989-92 5-15

1993 (mid 92 – mid 93) 17-35 (-46)

Normal control - 2-5 for submerged

- 20 for reed swamp.

Elimination not just control.

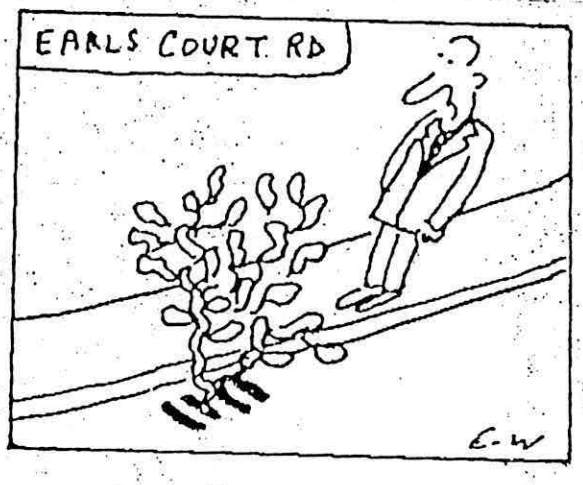
∴ low concentrations → discussions with manufacturers.

Publicity → LAW
[→ COST £1-2 for 90% control.]

THISTLE DIARY

Fast breeding reactors and weeds

Comment from Westminster by Tam Dalyell



BEWARE the Australian swamp stonecrop. Although it was first introduced into Britain in the early part of the century, it has become a problem only in the past 10 years—doubtless because it is widely sold by garden and aquatic centres as an oxygenator plant for aquaria. The plant has turned up at more than 300 sites throughout Britain, but mainly in the south and east of England and a few in Scotland. Allowed to spread, it will create havoc in Britain's ponds.

The Australian swamp stonecrop is not included among the plants whose release into the wild is prohibited by the Wildlife and Countryside Act of 1981, nor is any "outbreak" liable to an order made by the Secretary of State under the Weeds Act of 1959. English Nature, in part successor to the NCC, in conjunction with the Institute of Freshwater Ecology, has now issued a leaflet on how best to control the plant.

Funded by NERC, NCC, TERF
and Churchill Fellowship
travel by British Council / IFE

Crassula helmsii.

- vegetative reproduction (? one clone)
- small but v. dense stands
  (outcompetes plants to 2m tall)
- 'green' throughout year
  (no seasonal dieback)
- high no of nodes + stems
- Amphibious
  submerged emergent bank drying areas
- die back to tip
- floating turions in winter - blow around lakes
- uses nutrients if available
  (cp Britain vs Australia
- high resistance to herbicides
- Dispersal by man (planting) animals?

V. small seeds (mg) viability?
(♀ + ♂)

Log phases
- identification 10 years
flores 20 years

Primary/natural site invader (NRs)
+ man made habitats
1-3 years before visible.
⇒ needs immediate control

Biological control potential
Little evidence
- a minor species in Australia

High profile - low money available !!

The Future - feasibility of eradication & cost

Nature Reserves

- monitor 6-monthly
  (without introducing plant!)
- early control
  (resistance by 'conservation' but site 'lost' if not controlled)
- legal constraints.

European Weed Research Society International Workshop on Plant Invasions - Theory and Applications. 16-19 September 1993. Kostelec nad Černými lesy, Czech Republic.

CRASSULA HELMSII - ITS INVASION OF NORTH-WESTERN EUROPE AND THE POTENTIAL CONTROL STATAGIES FOR NATURE RESERVES.

F.H. DAWSON

NERC Institute of Freshwater Ecology

OUTLINE

The distribution and habitat in Australia
- competitors
- temperature - min/max
- rainfall
- water chemistry - nutrient, salinity
- water flow
- altitude

Prediction of distribution in NW Europe
- based on Climatic data for Australian habitat

The current situation in Europe

The reason for its present distribution Europe
- comparison of UK with mainland Europe

Guidelines - results of testing - reappraisal ?
- Test sites Corfe pond vs Lnyslas

Reasons for the difficulties of its control
- Its ultracompetitive characters
- biomass control vs eradication

The Future - feasibiltiy of eradication & cost

REFERENCES

Anonymous (1992). *Crassula helmsii* Focus on Control. Institute of Freshwater Ecology, Natural Environment Research Council & English Nature, pamphlet 8 pp. (5500 copies distributed)

Dawson F.H. and Warman E.A. (1987). *Crassula helmsii* (T. Kirk) Cockayne; is it an aggressive alien aquatic plant in Britain? *Environmental Conservation* **42**, 247-272. (Abstract in BSBI News **45**, 38-39, April 1987 and updates *Crassula* Watch 1, Nov. 1987 4 pp, *Crassula* Watch 2, Nov. 1988 4 pp, *Crassula* Watch 3, Nov. 1990, 4 pp).

Dawson F.H. (1988). The alien aquatic *Crassula helmsii* continues to expand its distribution in Britain. BSBI News **49**, 43.

Dawson F.H. (1989). Some attempts at the control of the alien aquatic *Crassula helmsii* (T. Kirk) Cockayne. BSBI News **51**, 46.

Dawson F.H. (1989). Natural habitat and population control mechanism of *Crassula helmsii* (Australian Swamp Stonecrop) in Australia. Report to the Winston Churchill Memorial Trust, 33 pp.

Dawson F.H. (1990). The spread of *Crassula helmsii* (Kirk) Cockayne in Britain. British Ecological Society *Industrial Ecology Group proceedings of a meeting on the biology and control of invasive plants*, University of Wales, College of Cardiff, 20-21 September 1990)

Dawson F.H. (1991). *Crassula helmsii*: comparisons of the habitat in Australia with those in Britain. BSBI News **57**, 48.

Dawson F.H. (1991). Distribution, dispersal and biology of the aquatic weed *Crassula helmsii* and its importance in agriculture. Fifth Report of TERF The Environmental Research Fund a review of activities 1989-90, 5-6.

Dawson F.H. & Henville P. (1991). An investigation of the control of *Crassula helmsii* by herbicidal chemicals (with interim guidelines on control) - final report. Report to the Nature Conservancy Council, 107 pp.

Dawson F.H. (1991) Distribution, dispersal and biology of the aquatic weed Crassula helmsii and its importance in agriculture. Fifth Report of TERF The Environmental Research Fund a review of activities 1989-90, 5-6.
(with abstract in More environmental research from TERF. Pesticides Outlook 2 (4) Nov 1991, 20.

Dawson F.H. (in press for 1993) The spread of *Crassula helmsii* (Kirk) Cockayne in Britain. In: Ecology & Management of Invasive Riverside Plants, Ed. M. Wade (The Proceedings of the first international workshop on the Ecology and management of invasive riparian and aquatic plants, Organised by J. Brock, L. de Waal & M. Wade, 22-23 April 1992, ICOLE, Loughborough University. (invited talk)

Dawson F.H. (1993) Comparison of the rates of naturalisation of the invasive alien aquatics *Crassula helmsii* and *Myriophyllum aquaticum*. *BSBI News* **63**, 47-48.

Dawson F.H. (1993) Controlling Aliens. New Scientist 138 (1877) 12 June 1993 (letter)

Dawson et al. (in prep) Distribution of genetic variation and growth of Crassula helmsii in Britain and Australia (with note to Wildlife Research in South Australian National Parks & Wildlife Service). (work completed, write up in hand)

Dawson & Brock M. (in prep) Distribution, variation drought tolerance and growth of Crassula helmsii. (work completed, write up in hand)

Dawson et al (in prep) Crassula helmsii. Biological Flora of British Isles (J.Ecol, registered as being undertaken) (in draft)

Dawson F.H. (in prep) Crassula helmsii In: Invasive and potentially invasive plants of North America (work completed, write up in hand

Fullard, H. & Darby H.C. (1969) The University Atlas George Philip & Son Limited, London, 111 pp.

Kluge M. (1982). Crassulacean Acid Metabolism (CAM) in *Photosynthesis Volume II, Development, carbon metabolism and plant productivity.* Ed. Govindjee. Academic Press, New York, 580 pp.

Richardson B.J., Baverstock P.R. and Adams M. (1986). *Allozyme electrophoresis. A handbook for animal systematics and population studies*, 410 pp.

Appendix 2

Plant Invasions - Theory and Applications

International workshop

September 16-19, 1993

Institute of Applied Ecology, Kostelec nad Černými lesy
Czech Republic

Abstracts

Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Are there differences between traits of invasive and non-invasive plant species in European wetland ecosystems?

V. J. Abernethy, J. M. Hills, M. R. Sabbatini and K. J. Murphy

Department of Botany, University of Glasgow, Glasgow G12 8QQ, United Kingdom

During 1991-93 data on invasive and non-invasive wetland plant species were collected from wetlands in England, France, Ireland, Scotland and Spain. Three vegetation types were selected for study; euhydrophytic, emergent and seasonally inundated. In each vegetation type, a suite of morphological traits was collected from invasive and non-invasive plant species. Multivariate data analysis was carried out to determine if invasive and non-invasive plant species had differences in traits and reproductive strategy in the three studied vegetational community types. The extent to which the degree of invasiveness of a plant species can be predicted from traits will be discussed.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Assessment of the genetic variation and spread of British populations of Japanese Knotweed *(Fallopia japonica)* and its hybrid *F.* x *bohemica*

J. P. Bailey[1] and L. E. Child[2]

[1]*Department of Botany, University of Leicester, Leicester LE1 7RH, United Kingdom*
[2]*International Centre of Landscape Ecology, Loughborough University, Loughborough, Leicestershire. LE11 3TU, United Kingdom*

It is thought that in Britain at least, *Fallopia japonica* var. *japonica* has a very restricted genetic base. Knowledge of the genetic constitution of this taxon would be very useful in the context of proposed Biological Control programmes. Preliminary results are presented on the application of isozyme and PCR RAPd analyses to different accessions of *F. japonica, F.*x *bohemica*, *F. sachalinensis* and the varieties of *F. japonica* from Britain, Continental Europe, Japan and China. The technical problems associated with using these techniques on Knotweeds are discussed. The results of a survey of the distribution of *F.* x *bohemica* in the British Isles are also reported and the role of seed in the spread of both *F. japonica* and *F.* x *bohemica* is discussed.

The distribution of an alien duckweed, *Lemna minuta*, within the British Isles; identification, niche constraints and dispersal strategies

J. L. Bramley and J. T. Reeve

Ecology Research Group, Christ Church College, Canterbury, Kent, United Kingdom

The United Kingdom has five native species of duckweed and it is perhaps surprising that an alien, *Lemna minuta*, went undetected for many years. It is now apparent that this species, originally from temperate areas of America, has a widespread, if somewhat patchy, distribution throughout Britain and Europe. Problems are still encountered in the identification of this species from other duckweeds particularly *Lemna minor*. By employing a combination of morphological characteristics and simple chemical techniques errors in identification can be minimized. Chemical and physical factors affecting the distribution of *L. minuta* have been explored and under certain conditions this duckweed can be an aggressive invader. Further work on both distribution outside the UK, and on inter- and intraspecific competition will be undertaken.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

The invasive nature of Japanese Knotweed *(Fallopia japonica)* is enhanced by vegetative regeneration from stem tissues

J. H. Brock[1], L. E. Child[2], L. C. de Waal[2] and P. M. Wade[2]

[1] *School of Agrobusiness and Environmental Resources, Arizona State University, Tempe, AZ 85287-3306, USA*
[2] *International Centre of Landscape Ecology, Geography Department, Loughborough University of Technology, Loughborough, Leicestershire LE11 3TU United Kingdom*

Greenhouse experiments were conducted with Japanese knotweed (*Fallopia japonica* (Houtt) Ronse Decraene)) during the months of May, June, and September 1992. Plant material was collected near Loughborough University of Technology, Loughborough, Leicestershire in the United Kingdom. The experiments tested the hypothesis that Japanese knotweed, known to regenerate from rhizomes, could produce new plants from stem tissues. Three portions of Japanese knotweed stems were harvested with each having 2 nodes. One segment was cut just above the soil surface, the middle segment at about a 0.5 m height, and the upper segment from 1.0 m or greater height. Stem materials were placed in a greenhouse in replicated treatments that changed slightly during experimentation. Treatments common to all experiments were water, stems buried with a slight covering of potting media, and stems oriented vertically with 1 node buried. A surface treatment was discontinued because of a lack of response, and added to the June and September experimental design were stems placed in shaded areas for comparison to ambient light conditions. Stems in water provided about a 60% success rate of generating new shoot growth. Stems buried in the vermiculite/peat potting media provided an average of about 40% shoot growth. Shoots with 1 node buried and placed vertically averaged about 15% shoot regeneration. Stems in shade had slightly greater shoot regeneration success compared to those subjected to sun light. Adventitious roots were produced near the base of new shoots about 21 days following initial growth. Root formation ranged from about 5% to 25% in the May/June to September experiments. Shoot height at 30 days of age tended to decrease from the May, June, and September plantings, but the average number of 4 leaves per new shoot, remained stable across the experiments. Stem segments harvested in early September produced both vegetative and floral shoots. Floral shoots tended to be initiated more rapidly than did vegetative shoots. Floral shoots were observed on about 20% of the nodes, with stem segments in the water and buried stems having the highest occurrence of flowering tissues. Like many of the vegetative shoots, floral shoots had died by the time the experiment was terminated. Based on our results, stems of Japanese knotweed, given good microclimate conditions, can produce new shoots, produce roots, and provide new plants. Stem tissue can be readily transported by flooding or anthropic activities, thus the potential to form new colonies of Japanese knotweed from stems tissue needs to be recognized by land managers.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Growth characteristics, invasive potential and control of Giant Hogweed in Ireland

J. M. Caffrey

Central Fisheries Board, Mobhi Boreen, Glasnevin, Dublin 9, Ireland

Giant Hogweed (*Heracleum mantegazzianum*) is an invasive perennial plant whose rate of spread in Ireland, in recent years, may be considered exponential. The plant has expanded its range from river corridors and is now firmly established in a diversity of terrestrial habitats. The uncontrolled expansion of this species within the country is a cause for concern, not only because of the serious human health hazard that it represents, but also because of the ecological, hydrological, river engineering and access problems that the plant stands can present. This paper describes the growth characteristics and seed generating capacity of Giant Hogweed plants in a range of habitat and substrate types. The effect that cutting, timing of cut and treatment with herbicides has on growth and seed production is also described. The requirement for the speedy implementation of a national and co-ordinated Giant Hogweed control strategy is stressed and a suggested control and education programme is presented.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Treatment of *Crassula helmsii* - a case study

L. E. Child[1] and D. Spencer-Jones[2]

[1] *International Centre of Landscape Ecology, Loughborough University, Loughborough, Leics. LE11 3TU, United Kingdom*
[2] *Water Wise Consultancy, Plowmans, Park Road, Forest Row, Sussex, United Kingdom*

Two sites infested with the aggressively invasive aquatic and marginal plant *Crassula helmsii* were selected for herbicide trials over the summer of 1992. All three forms of the plant were treated, the submerged form with diquat alginate, the emergent marginal form with glyphosate and floating vegetation with diquat. A reasonable level of control of the emergent form of *C. helmsii* was achieved with glyphosate with a 75 % reduction in plant height recorded. Neither diquat nor diquat alginate controlled the floating or submerged forms of the plant.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Invasive behaviour of alien annuals

P. Eliáš

Institute of Botany, Slovak Academy of Sciences, SK-842 23 Bratislava, Slovakia

Some of alien annuals behave invasively in new territories after introduction by man, viz. they fastly and spontaneously increase their adventive geographical distribution, penetrating into synanthropic and/or seminatural (more rarely also natural) plant communities. Two questions are addressed to the problem: (i) What are the properties of plant species to be invaders ? and (ii) What environmental features render a habitat to be vulnerable by invasion ? Invasive behaviour of alien annuals was studied by the author in Central Europe viz. in Slovakia and surrounding countries, using three plant species. (1) *Impatiens parviflora* DC., from Central Asia, invades mesic forest communities, clear-cutt areas and ruderal communities. (2) *Impatiens gladulifera* Royle, originates from Himalayas, invades floodplain forests along large rivers and wet ruderal habitats. (3) *Iva xanthiifolia* Nutt., from North America, invades ruderal communities and crops (it is considered as a quarantine weed), colonizes new habitats in human settlements. Both *Impatiens* species are early summer or summer species, *I. xanthiifolia* is late summer species. They are sun species (heliophytes), extremely tall or tall erect annuals, eventually with high stress tolerance (shade tolerance at *I. parviflora*). Common attributes of the invading species ("invaders") and features of plant communities invaded by them ("invasibility") were found. Spread rate and extension of adventive distribution area in Slovakia (Central Europe) were documented. Local process of *I. parviflora* invasion in formely I. B. P. Forest Research Area at Báb (SW Slovakia) have been studied using quadrat and population dynamics methods. Changes in frequency and cover (population density) were monitored from year to year on permanent plots. The following invasive properties were considered: high seed production (high reproductive effort or output), short distance dispersal of seed in the vicinity of mother plants, simultaneous (synchronized) seed germination and seedling emergence, forming of dense leaf canopy (dominance) yet at seedling stage, rapid vegetative growth of young (juvenile) and reproductively mature individuals, tall dense stands of adults with large leaves (LAI), size hierarchy features promoted success in competition with native flora species (competition ability), absence or limited frequency/density of native predators (incl. diseases), competitive ruderal strategy. Both *Impatiens* species are sensitive to summer droughts (extremely high mortality of adults occurs in summer), wintering in seed pool (bank) at and/or near soil surface. Long distance dispersal (of seed) is supported by man and/or by water (*I. glandulifera*). The invaders predominantly occupied disturbed sites in natural vegetation and/or they colonized open areas in anthropogenic habitats. Establishment of local centres, served as heavy source of seeds (diaspores), is important for further expansion in range and density.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

The invasive component of the macroflora from river systems within agricultural mediterranean areas

M. T. Ferreira and I. Moreira

Instituto Superior de Agronomia, Tapada da Ajuda, P-1399 Lisboa, Portugal

The lotic vegetation and corridors of river Sorraia and its direct tributaries were surveyed during growth seasons of 1986-89 and all species within banks were recorded. The Sorraia hydrographic basin spreads throughout Central Portugal and most of its area is occupied by cork-oak forest and by rice and other water-consuming Mediterranean crops. The adventitious terrestrials found within the river system are dominated by crop weeds and its richness was found to increase significantly towards downstream and with the intensification of the agriculture activities surrounding the river corridor. Many river species are common invaders of irrigated crop fields and rice fields. A frequency analysis and a UPGMA cluster analysis were performed to show the association between some lotic species and the major types of land use. The invasive (weed) character of some river species within the river system was also studied as well as the effects of weed cuttings and river regulation, namely on *Salix alba* ssp. *vitelina* and the exotic haloragacean *Myriophyllum aquaticum*. Invasive plant movements both to and from the river system are discussed as well as the resilience and spreading capacity of this invasive flora, strongly connected with the surrounding agricultural systems.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Classical biological control for invasive aquatic and riparian weeds: current programmes and future prospects

S. V. Fowler[1], H. Evan[1] and D. Schroeder[2]

[1]*International Institute of Biological Control, Silwood Park, Ascot SL5 7TA, United Kingdom;*
[2]*IIBC European Station, 1 Chemin des Grillons, Delemont, Switzerland*

Classical biological control involves the introduction of exotic natural enemies to control a target pest. The technique has seldom been used for weed control in Europe, although Europe has been the source of many weed biocontrol agents that have been used successfully in other parts of the world. When successful, classical biological control provides an economically and environmentally satisfactory method of weed suppression. It is particularly appropriate for weed control in ecologically sensitive areas where mechanical control of weeds or the use of herbicides are undesirable. The overall success rate and predictability of classical weed biocontrol programmes have been rather low, but aquatic weeds in particular have been successfully controlled in a large number of programmes worldwide. This poster presents a brief review of classical biocontrol used against aquatic and riparian weeds, concentrating on current programmes at the International Institute of Biological Control. Finally, several prospective targets for classical weed biocontrol in Europe are highlighted.

After-fire invasion by alien weeds - a five year study from Argentinian *Nothofagus* forest

M. Gobbi, S. Calvelo and J. Puntieri

Centro Regional Universitario Bariloche, cc 1336, 8400 Bariloche, Argentina

Early vegetation succession was studied in two sites of the Subantarctic Forest Region of Argentina affected by an extensive fire in 1987. One of these sites (A) was dominated by a shrub morph of *Nothofagus antarctica* and the other one (B) by a tree morph of that species. The vegetation cover (%) was assessed one, two, three and five years after the fire in 25 to 35 1 m^2 plots in each site. The degree and vigour of recovery of *N. antarctica* was evaluated. There was high variability in the species present in the plots. The ordination of species using Canonical Correspondence Analysis using year and site as covariables accounted for 18% of the variability between sample units. The species richness was initially higher on site A but it was higher on site B after five years mostly due to the co-ocurrence of native and alien species in the latter. The diversity was similar in both sites after five years. The plant cover only differed between sites after five years of secondary succession, when it was higher on site B (50%) than on site A (20%). One year after the fire the most important species in both sites was *Muehlenbeckia hastulata*, a native climbing undershrub, but that species almost disappeared from both sites four years later. By the fifth year the most common species on site A were *Phacelia secunda* (a native perennial herb) and *Diostea juncea* (a native shrub), whereas on site B were aliens *Rumex acetosella* and *Verbascum thapsus*, which, in each case, made up more than 50% of the total plant cover. Alien species represented 3% of the total cover on site A and 72% on site B. The degree of resprouting of *N. antarctica* from root crown was similar in both sites, but its vigour was higher in site B. The different degree of land use in these two sites before the area was fenced could explain their substantial differences in invasibility by alien species.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Rhododendron ponticum in the Snowdonia National Park - its success as an invasive species

R. H. Gritten

Snowdonia Natural Park, Penrhyndeudraeth, Gwynedd LL48 6LS, United Kingdom

Rhododendron ponticum is a very successful invasive species found growing in a large variety of different habitats covering a significant area of the Snowdonia National Park, North Wales. Its distribution and the reasons for its success as an invasive species are discussed. A scheme, now in its third year, to control an extensive area of *R. ponticum* is described and an assessment made to predict the ultimate outcome of the present control strategy. Finally, a general overview is given describing several other successful invasive species troubling the National Park and the reasons for their success are discussed.

Time-lags in biological invasions with regard to the success and failure of species

I. Kowarik

Universität Hannover, Inst. f. Landschaftspflege und Naturschutz, Herrenhäuser Str. 2, D-3000 Hannover, Germany

Time in biological invasions is usually regarded as studying the growth of populations and changes in the spatial distribution of species. Difficulties in predicting the future performance of an exotic species may partly result from a possible lag-phase between the release and the beginning of the spontaneous spread of an introduced species. Taking the woody flora of Brandenburg, Germany, as an example, I calculated the time-lags between the first introduction and spread for 184 species. The results show a wide range including species which began to spread only centuries after their first introduction. The success or failure of the introduced woody species was analysed in two dimensions: (a) their ability to establish (naturalize) permanently and (b) their frequency, both on man-made and natural sites. Finally, the ability of exotic species to spread quickly after their first release is related to their success or failure.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Diversity and species richness of goldenrod communities in riparian habitats in the north-western Croatia

G. Lukač

Department of Botany, Faculty of Science, University of Zagreb, Croatia

Goldenrod (*Solidago gigantea*) is a a common neophyte species in riparian habitats in Croatia. In some riparian habitats, this species creates monospecific stands or appears in mixed stands with many plant species, e.g. *Helianthus tuberosus, Artemisia vulgaris, A. verlottorum, Saponaria officinalis*. In these stands, *S. gigantea* attains various degree of dominance. Plant diversity and species richness of the stands depend on the degree of goldenrod dominance. On the basis of more than 300 releves and about 200 m^2 of transects, the diversity and species richness of goldenrod stands in the north-western Croatia was investigated. The expansive capacity of *S. gigantea* can be related to many bioecological characteristics such as clonal growth, dense root system, and allelopathic interactions. All of these features provide goldenrod with a high capacity for colonization of riparian habitats in Croatia and will be discussed in this paper.

Relating invasion success to plant traits: an analysis of the Czech alien flora

P. Pyšek[1] and K. Prach[2]

[1]*Institute of Applied Ecology, University of Agriculture Prague, CZ-281 63 Kostelec nad Černými lesy, Czech Republic*
[2]*Institute of Botany of the Czech Academy of Sciences, and Faculty of Biology, University of South Bohemia, CZ-379 82 Třeboň, Czech Republic*

Alien flora of the Czech Republic, central Europe, was analysed with respect to the effect of plant traits on the species invasion success. The list of species introduced into the Czech Republic after 1492 (i.e. neophytes) was compiled using available local sources. Assessment of the invasion success was carried out empirically using semiquantitative scale of species abundance in the landscape. Seminatural and man-made habitats were treated separately. Altogether 132 species appeared on the list (about 5% of the Czech flora). About 20% of the total number of aliens may be considered successfully naturalized. Differences in taxonomical position, life form, life strategy and ecological requirements were found when alien species were compared with native flora. Successful invaders into seminatural vegetation differed from those naturalized in man-made habitats in the area of origin, taxonomical position, stature, life form, life strategy, dispersal agents, planting history and ecological requirements. No differences between both groups were found regarding pollination agents and mode of reproduction. The potential of studies comparing large species sets for searching for general characteristics of invasive aliens and limitations to such sort of research are discussed.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

Reynoutria sachalinensis in the Far East and in Europe

H. Sukopp and U. Starfinger

Institut für Ökologie der Technischen Universität Berlin, Schmidt-Ott Str. 1, 1000 Berlin 41, Germany

The native range of the Sakhalin Knotweed (*Reynoutria sachalinensis* (F. Schmidt Petrop.) Nakai)) is Southern Sakhalin, the Southern Kuril Islands and Northern Japan (Hokkaido; on Honshu only on the side of the Japanese Sea). It is there a component of communities of "giant herbs" with plant heights of more than 4 m, which can be found nowhere else except of the tropics. It is mostly floodplain vegetation in valleys or in moist lowlands; in Southern Japan in the subalpine zone. This vegetation is confined to a moist and maritime climate. The standing crop of *Reynoutria* can reach 11.7 MJ ha -1, which is more than any other herbaceous vegetation. The giant herb communities are distinguished not only by their high production but also by their ability to make extremely effective use of the sunlight under favourable water and nutrient conditions. This is attained by an optimal arrangement of leave surfaces in space: The upper leaves are sloping or almost vertical, the lower leaves horizontal, ensuring that the solar radiation is completely absorbed. In the reproductive phase the leave arrangement changes from 2/5 dispersed to distichous. This leads to the horizontal display of flowers above the leaves making access for polluting insects easy. The entomophilous flowers yield anemochorous fruits. In Japan, natural stands of *Reynoutria* occur on sites subject to natural disturbance of the soil: gravel slopes along coastal cliffs, banks of mountain rivers, avalanche areas or forest edges. Under anthropogenous influence they are mostly found as successional vegetation on road verges or fallow land. *R. sachalinensis* was first introduced into Europe in 1863 as an ornamental and for fodder use. Today, leaf extracts are used for mildew control in greenhouses. Also, there are experiments to use it in soil decontamination for its ability to accumulate heavy metals. In Germany, stands of *R. sachalinensis* on river banks and in parks can be classified within the Aegopodion phytosociological unit and those on ruderal sites within the Arction.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

The distribution, biology and control of Giant Hogweed in Scotland

G. E. D. Tiley and B. Philp

Scottish Agricultural College, Auchincruive, Ayr, Scotland, United Kingdom

Following its introduction in the 19th century, Giant Hogweed (*Heracleum mantegazzianum* Somm. et Lev.) has spread widely in lowland areas of Scotland where it is a locally abundant weed along the banks of rivers and waste places. It is now spreading to roadsides and into many areas of the general countryside. A map of its current distribution has been prepared, based on local surveys. The results of preliminary studies on the biology of the plant at Auchincruive are given. Perpetuation and spread depend on germination of the previous season's seed crop. The resultant stand of plants grow vegetatively for 2-4 years before monocarpically flowering. Single mature plants weighed over 30 kg fresh weight at flowering, 7 kg dry weight, at approximately 19% DM. Biomass was distributed evenly between stem, leaves and inflorescences. DM percent varied from 12% petioles, 20% leaf blades, 16% stem, 25% roots, 21% inflorescence. Viability of seed varied considerably with dates of collection and post-harvest treatment. Methods of control are based on: (a) prevention of flowering and fruiting, by physically cutting or chopping mature flowering plants. Recovery of the plant and secondary flower head production depends on the height of cutting. (b) Reduction or eradication of vegetative stands using mechanical or chemical methods. These are preferably applied early in the growing season. Cutting, slashing, chopping or grazing by cattle or sheep are the chief mechanical methods. Glyphosate is the main herbicide used, though suitable spraying opportunities can be limited early in the season. Local programmes of control have been initiated in many areas with varying levels of success. A systematic strategy is required within each river catchment to ensure complete control. Further studies are desirable on the conditions necessary for flower induction, seed maturation and post-harvest treatment, on seed germination dormancy and on efficiency of herbicide use.

"Plant Invasions - Theory and Applications" international workshop
September 16-19, 1993, Kostelec n. Č. l., Czech Republic

The dispersal strategies of weeds in Denmark

U. Vogt Andersen

Royal Veterinary and Agricultural University, Botanical Section, Rolighedsvej 23, DK-1958 Frederiksberg C, Denmark

One part of landscape design involves challenging nature by the introduction of alien species into new habitats. Some of these species possess abilities to be invasive weeds in the Danish landscape. This paper considers the dispersal strategies of these invasive weeds compared to those of the common weeds occurring in arable fields. Dispersal strategies are determined and dispersal spectra are constructed using diaspore morphology as evidence for mode of dispersal. The dispersal spectra are found to be significantly different. Among the common weeds censer mechanisms, epizoic, and "no special device" dispersal are the most prevalent of the dispersal spectrum. Wind dispersal is important for both groups, whereas water and endozoic dispersal appears to be very important among the invasive weeds. Vegetative propagation plays an important role for both groups, and is in fact the only way of dispersal for several invasive species. All weeds are widespread as a result of human activities. Of course one cannot determine whether or not a species is going to be invasive out from it's dispersal strategy alone. Persistance of seeds in soil, and competitive ability are among the other factors that must be accounted for.

Field trials: treatment of *Fallopia japonica* - a case study

L. C. de Waal

International Centre of Landscape Ecology, Loughborough University, Loughborough, Leicestershire, LE11 3TU, United Kingdom

Two sites, each with a dense monoculture of the invasive and vigorously growing *Fallopia japonica*, were selected for herbicide trials during the summer of 1991 and 1992. One site was chosen for regular treatments at different times throughout the growing season. Plots within this site were treated with either 5 l/ha glyphosate or 5 l/ha glyphosate with the addition of 2 % Mixture-B. Both treatments were made using a low water volume (80 l/ha) and were applied through a specifically recommended very low volume nozzle using a knapsack sprayer. A reasonable level of control, up to 100 % kill, were achieved with both treatments. The second site was used for more experimental trials, which included pouring concentrated glyphosate in the hollow stems of the plant. These treatments did not seem to affect the plants at all.

Appendix 3

EUROPEAN WEED RESEARCH SOCIETY

International Workshop

First Circular - call for papers

Plant Invasions in Aquatic and Riparian Habitats - Theory and Applications

16 - 19 September 1993

Institute of Applied Ecology, Kostelec, Czechoslovakia

Institute of Applied Ecology
CS - 281 63 Kostelec n. C. 1.
Czechoslovakia

Plant Invasions - Theory and Applications

The general question raised by the workshop will be "Which species traits and habitat characteristics make a species invasive?"

The scientific programme will consist of lectures (both invited lectures and those offered from participants), posters, discussions and a one day excursion. Both theoretical papers and case studies on invasive species will be accepted for inclusion in the programme.

Accommodation will be provided by the Institute of Applied Ecology, Kostelec.

Registration fee is provisionally set at £80 and includes accommodation, full meals and excursion.

If you are interested in participating in the workshop and to ensure that you are kept informed of developments, please complete and return the attatched form.

Correspondence address: Petr Pysek
Institute of Applied Ecology
CS - 281 63 Kostelec n. C. 1.
Czechoslovakia
Fax: 42 - 203 - 97500
Tel: 42 - 203 - 97521

Plant Invasions - Theory and Applications

16 - 19 September 1993
Kostelec, Czechoslovakia

Czech Rep.

Preliminary application

Name:
F.H. Dawson

Address:
Institute of Freshwater Ecology, River Laboratory, East Stoke, WAREHAM, Dorset BH20 6BB, U.K.

Title:
Dr

I wish to attend .....

I should like to present a ..... paper/~~poster~~

Proposed Topic:

Crassula helmsii its invasion of north western Europe and the potential control strategies for nature reserves

Please return this form to:

Petr Pysek
Institute of Applied Ecology
CS - 281 63 Kostelec n. C. I.
Czechoslovakia
Fax: 42 - 203 - 97500
Tel: 42 - 203 - 97521

010

- 205863

SENT
D: 2.6.93

Institute of Freshwater Ecology

River Laboratory

East Stoke, Wareham
Dorset BH20 6BB

Telephone (0929) 462314
International (44929) 462314
Facsimile (0929) 462180
Telex 94070672 – WARE G

Professor A. D. Berrie BSc PhD CBiol FIBiol
Head of Southern Division

FAX Information Sheet

To: Mr Bill Jefferson

From: Dr F.H. Dawson

Total no. of pages: 1

Date sent: 2 June 1993

Dear Mr Jefferson

Request for small travel grant

I expect to visit Kostelec ($50^0$14'N $16^0$35'E) in the north of the country for a workshop on Plant Invasions - Theory and Application. It has been organised by Peter Pysek at the Institute of Applied Ecology. It is a follow-up to one held at Loughborough University in April 1992 and was attended by several scientists from Czechoslovakia and other European countries.

I would like to extend my visit for a week or two to enable me to study and discuss in greater detail problems associated with the environmental and economic complications of such invasions.

Is funding available for such purposes (i.e. subsistence and extra travel) and how does one apply?

Yours sincerely

F. Hugh Dawson

F.H. Dawson

Institute of Freshwater Ecology

River Laboratory

East Stoke, Wareham
Dorset BH20 6BB

Telephone (0929) 462314
International (44929) 462314
Facsimile (0929) 462180
Telex 94070672 – WARE G

Professor A. D. Berrie BSc PhD CBiol FIBiol
Head of Southern Division

FAX Information Sheet

To: Mr Bill Jefferson, OBE
Director of British Council, Prague

From: Dr F.H. Dawson

Total no. of pages: 10

Date sent: 16 June 1993

Dear Mr Jefferson

Request for travel grant

I refer to my recent letter requesting funding for travel and subsistence to visit Kostelec (50°14'N 16°35'E) in the north of the country for a workshop on Plant Invasions - Theory and Application which has been organised by Peter Pysek at the Institute of Applied Ecology. This workshop is a follow-up to one held at Loughborough University in April 1992 which was attended by several scientists from Czechoslovakia and other European countries (statement enclosed).

However, your colleague explained when she rang that a possible grant would only extend to travel and, to that end, I apply for travel money to visit this outlying Institute, to attend the workshop and to study and discuss in greater detail problems associated with the environmental and economic complications of such invasions.

I am attaching my professional CV (short form) and publication list, a statement drawn up for the previous meeting covering the need for continued work in this area, the application form and acceptance for the workshop. The outline of my contribution to the workshop is not yet in any presentable form but is an extension of the previous paper - a summary of which is enclosed - and focuses upon the potential distribution and control strategies necessary for various natural sites within Europe.

Yours sincerely

F.H. Dawson

To whom it may concern

Herewith I confirm, that dr. Hugh Dawson will participate at the international meeting PLANT INVASIONS - THEORY AND APPLICATION in Kostelec nad Černými lesy, Czech Republic (16.-19.9.1993) and his lecture Crassula helmsii - its invasion of north western Europe and the potential control strategies for nature reserves was included into the scientific programm of the meeting.
The registration fee was set at 80 GBP.

Kostelec, 9 June 1993

Petr Pyšek
Institute of Applied Ecology
University of Agriculture Prague
CZ-281 63 Kostelec n.Č.l.
Czech Republic

Tel 42-203-97521
Fax 42-203-97500

Dr Anne Wozencraft
Assistant Director
The British Council
Národní 10
125 01 Prague 1

14 July 1993

Dear Dr Wozencraft

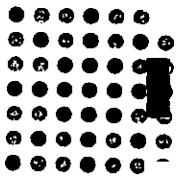
Thank you very much for the contribution to travel funds for the above workshop; it is most helpful. Please forward my thanks to the Director, Mr Bill Jefferson OBE.

I will provide a report on my return to England with the programme and objectives reached from the meetings and visits.

Yours sincerely

F.H. Dawson

The British Council



Our ref

Your ref

Tel ext

PRA/365/2

Promoting cultural, educational
and technical co-operation between
Britain and other countries

Národní 10
125 01 Prague 1
Telephone 20 37 51-5
Telex 12 20 97 BCCZ C
Fax 20 58 63

Mr F H Dawson
River Laboratory
Institute of Freshwater Ecology
East Stoke
Wareham Dorset BH20 6BB

0042

01/07/1993

Dear Mr Dawson,

TRAVEL GRANT APPLICATION

I am pleased to inform you that we are willing to contribute to your travel expenses to the Czech Republic. Enclosed please find a cheque for pounds 200. Following your return to Britain, we would be very grateful if you could provide us with a report, which summarizes the purpose of your visit, the programme that you followed and the objectives that were reached.

Yours sincerely,

A. Wozencraft

Dr Anne Wozencraft
Assistant Director

88

MEMORANDUM

To: Gwyn

From: Hugh

Date: 14 July 1993

Subject: Attendance at Czech Workshop on Plant Invasion, Kostelec, September 1993

The British Council has given me a contribution to travel (only) funds of £200 to attend the above workshop and to present a paper. Does the offer to match such funds from IFE still stand?

Fax Information Sheet

Institute of Freshwater Ecology

Windermere Laboratory

Far Sawrey
Ambleside
Cumbria LA22 0LP

Telephone 05394 42468
Facsimile 05394 46914
Telex 94070416 WIND G

Professor J. Gwynfryn Jones DSc CBiol FIBiol
Director

Dr. A. D. Pickering BSc PhD DSc
Head, Northern Division

To Dr F H Dawson

From Professor J G Jones Ext 270

Dept Director

No. of peges including header 1 Date sent 20 July 1993

Message

Subject: ATTENDANCE AT CZECH WORKSHOP ON PLANT INVASION, KOSTELEC, SEPTEMBER 1993

Thank you for your memo dated 14th July concerning funds to attend the above Workshop. The IFE will match the funds supplied by the British Council (£200).

Best wishes.

Yours sincerely

Margaret Thompson (Mrs)

pp. Professor J Gwynfryn Jones

Director

Please acknowledge receipt

Natural Environment Research Council

Based on recycled paper


Natural
Environment
Research
Council